SCIENCE

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CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

GERMAN SCIENTIFIC APPARATUS.

TO THE EDITOR OF SCIENCE: At the International Exposition, Paris, 1900, the jury having in charge Group III., Class 15, Instruments of Precision, Moneys and Medals, were very much impressed with the German exhibit. This exhibit was arranged in a different way from that used by any other nation. Germany made a joint exhibition of mechanicians and opticians, and arranged their apparatus in sections embracing certain classes of instruments, and thus departed from the usual custom of arranging the exhibits under various firms. This enabled the jury to see at once all instruments of the same kind grouped together in one case.

The German Association printed complete catalogues describing and illustrating the apparatus exhibited, and these catalogues and descriptions were of very great assistance to the jurors in making awards.

The catalogues printed an introduction, which gave in a very condensed form the history of the work done in Germany in improving the manufacture of instruments of precision. I enclose an English translation of this introduction furnished by the German Association, and suggest that it be published in full in SCIENCE, inasmuch as it shows by what methods the German mechanicians have been able to produce such splendid results.

J. K. REES,

Member of the Jury, Group III., Class 15.

On this auspicious occasion, when the great French nation has invited the peoples of the world to inaugurate the 20th century by joining together under her hospitable sky in a brilliant exhibition of the works of peaceful competition, it would not seem irrelevant to glance back upon the departed century. It has been essentially an age of scientific and technical development and, naturally, the mechanical and optical trades claim a prominent share in the progress of mankind within the last hundred years. If we compare our present fundamental basis of all scientific measurements, our weights and measures, in their present perfection, with those existing a hundred years ago; if we place our finest astronomical and surveying instruments side by side with the to us almost primeval forms as they existed at the beginning of the century; or if we glance at our present sensitive physical and electrical measurements, remembering that a hundred years ago these were undreamt-of things, or in existence only in the crudest form, we cannot escape from a gladdening appreciation of the enormous progress made within the last century in the construction of philosophical instruments, as well as their reaction upon the progress of scientific investigations by dint of improved methods. A prominent share in this development of the aids of science is due to the German mechanicians and opticians.

At the commencement of the 19th century the French and English makers of scientific instruments were far in advance of the Germans. True, the 18th century knew of prominent mechanicians, and at the very beginning of the 19th century Fraunhofer and Reichenbach and their disciples, Repsold, of Hamburg, Pistor, of Berlin, and others, had secured general respect, in the scientific world, for German mechanical skill; yet the French and English makers took the lead at that time, so as to almost supply the world's entire demand in scientific instruments. This predominance had the further consequence of causing young Germans to emigrate to France or England in order to thoroughly master their subject. Many a German mechanician of the present day owes to French or English masters a substantial portion of his knowledge, and even in these days it is the aspiration of many a Teuton to widen his practical knowledge in France or England. The prominent position of the French and English instrument-makers was mainly due to the support which in both countries the State bestowed upon technical art. In England, the interests of the navy and merchant service gave rise to the assiduous development of astronomical and nautical measuring instruments, more particularly of astronomical chronometers, so as to ensure in these branches an absolute supremacy, which German mechanicians have only within the last ten or twenty years been able to contest. France owed her prominent position to the great geometrical survey of Cassini and his followers and, in a still greater degree, the admirable comprehensive labors leading to the establishment of the metrical system of weights and measures, which in its turn resulted in far-reaching improvements in the construction of appliances for weighing and measuring, astronomical and surveying, physical and chemical instruments.

In Germany, it is only within the last twenty or twenty-five years that the State has espoused the interests of the home industry in scientific instruments, but such have been the efforts and results that the position has, at a blow, as it were, changed in favor of Germany. Every possible encouragement was offered and great problems were created by the expenditure of the German governments, within the last thirty years, on art and science, the establishment of numerous large physical and chemical laboratories, the erection of new and the ex-

pansion of old observatories, the requisition of greatly improved surveying and astronomical instruments. Great progress resulted from the introduction of the metric system in the construction of exact weights and delicate balances, and, in compliance with the requirements of modern meteorology, led to vast improvements in thermometry and barometry. The development of the German navy created a great demand for nautical instruments. All these influences roused the productive powers of the nation and success has not been wanting.

Soon also the necessity was recognized of the close cooperation of the scientists and practical men. Accordingly, in 1879, several scientists, mechanicians and opticians united in Berlin and formed the nucleus of the German Association of Mechanicians and Opticians, which was formed in 1881 and embraced the whole German Empire, having for its object the scientific, technical and commercial development of philosophical instrument-making. The official organ of this Society, the *Zeitschrift für Instrumentenkunde*, was likewise founded in 1881 and is devoted to the theoretical and practical development of scientific instruments. Specialized schools were established, first in Berlin, then in Frankfort-on-the-Main and subsequently in many other towns, where savants and practical men are combined in training the rising generation in the theoretical departments of the subject. As a result of these serious scientific aims, German mechanicians and opticians sought in their laboratories and workshops the assistance of scientists, and at the present time the majority of the leading German firms retain one or more experienced mathematicians or physicists in their permanent service.

The greatest share of the impetus given to the manufacture of scientific instruments, however, is due to the Imperial Physical and Technical Institute, which was established in 1887. The first, or scientific, department of this important institution is devoted to purely physical research, whilst the second, or technical, department deals with matters concerning the construction of philosophical instruments. This institution has already done great service, and a large proportion of recent progress is due to its stimulating and helpful influence.

Seeing how comprehensive and systematic are the efforts brought to bear upon the art and science of instrument construction, it is not surprising that in this department Germany occupies now a foremost position. This fact was already apparent on the occasion of the Universal Exhibition of 1888 at Brussels, even more strikingly so at the World's Columbian Exhibition at Chicago in 1893, and remarkable achievements were shown by the combined members of the German Association of Mechanicians and Opticians at the Berlin Trades Exhibition of 1896.

After witnessing this steady development of our mechanical and optical trade, we cannot but look with confidence and gratification upon the practical demonstration at the Paris Centenary Exhibition of the flourishing state of the scientific instrument trade in Germany, and a characteristic feature of the latter is the unity of its aims, which is traceable to the history of its development and its intimate connection with pure science. It appeared, therefore, desirable to depart from the usual custom of grouping the exhibits under various firms, and rather to place them in sections embracing certain classes of instruments, so as to demonstrate on broad lines and as a whole, within a well-arranged though condensed area, the present position of German mechanical and optical art.

The Joint Exhibition of German Mechanicians and Opticians is, accordingly, subdivided into the following sections :

I. Metrological and Standardizing Instruments.
II. Astronomical Instruments.

III. Surveying and Nautical Instruments:—a. Geometric Instruments, b. Surveying, Mining and exploring Instruments, c. Nautical Instruments.

IV. Meteorological, Geo-magnetic, Thermometric and Calorimetric Instruments.

V. Optical Instruments:—a. Photometrical Appliances; b. Spectroscopes and Optical Measuring Instruments; c. Microscopes and their auxiliaries; d. Photomicrography and Projection; e. Photographic Ojectives; f. Hand Telescopes and Terrestrial Telescopes; g. Crystaloptics, Appliances for demonstrating and observing the Phenomena of Light.

VI. Electrical Measuring Instruments for Scientific Purposes.

VII. Electro-medical, Physiological and Biological Instruments.

VIII. Appliances for Chemical and Chemico-physical Research, Laboratory and Educational Apparatus.

IX. Drawing and Calculating Appliances.

X. Appliances for the Examination of Materials and for Special Purposes, Special Tools and Auxiliaries.

Following the plan of grouping the exhibits into sections according to subjects of applied science, it may be profitable to append a short sketch of the present position of philosophical instrument-making in Germany.

I. German mechanicians found themselves for the first time in their history face to face with a task of some magnitude when called upon, some seventy years ago, to construct metrological and standardizing appliances for the purpose of determining, under the direction of the great astronomer Bessel, the standards of the old Prussian system of measures. Subsequently, the mechanical arts received an important impetus through the introduction of the metric system in general and the influence and requirements of the Standardizing Commission in particular. The numerous inducements and hints which German mechanicians have received from the Standardizing Commission have enabled them to effectually cooperate in the introduction of the metric system both in and outside Germany. Opportunities presented themselves for the construction of very exact comparators, dividing engines, terminal and divided measures, balances of the highest degree of precision, etc.; and while acquitting themselves of these tasks, German mechanicians have both learned and accomplished much. A considerable portion of the equipment of the 'Bureau international des poids et mesures' has proceeded from German workshops. The achievements of Germany in the department of metrological instruments and appliances are prominently demonstrated within the Joint Exhibition of Mechanicians and Opticians by the Special Exhibits of the Imperial Normal-Aichungs-Kommission [Office of Standards].

II. From the measures, the indispensable fundament of all exact research, we proceed to the astronomical instruments. This department is necessarily at a disadvantage inasmuch as the largest and most costly instruments, the large refractors, can only be exhibited under very special circumstances. Hitherto German telescope-makers have supplied large refractors almost exclusively to countries outside Germany, but in this respect they have actively competed with other makers. Recently they have been given an opportunity of proving their powers in the construction of the new Potsdam refractor, which is not only one of the largest instruments in Europe, but also the first large telescope built for a German observatory, and the results have been brilliant indeed. In the main, the German makers have devoted their attention to the construction of medium-sized and small astronomical instruments, refractors, transit-circles, altitude circles, heliometers, etc., but with such success that, as regards the precision and delicacy of the individual parts of the instrument, Germany stands now unrivaled. Recently great progress has been made in the construction of astronomical objectives. The first optician who broke the ice in the important department of

optical glass smelting was a German, to wit Fraunhofer. His untimely death was followed by a long period of stagnation, and the limits of the possible were soon reached when attempts were made to construct very large objectives, at least as far as the optician's art was concerned. About twenty years ago, Professor Abbe and Dr. Schott, of Jena, resumed the thread where Fraunhofer had left off, and they succeeded in producing the old crown and flint-glasses in such perfection that the chromatic differences of spherical aberration can be compensated almost completely. This led to great improvements in telescope lenses, and at the same time the Jena Glass Works have become so productive as to enable German opticians to cover their entire demand in Germany. Great progress has also been made in such an important branch of manufacture as that of spirit-levels. Not only are the finest spirit-levels incontestably made in Germany, but, in addition, the Imperal Physical and Technical Institute has successfully investigated the causes of the formation of deposits within the levels. Mechanicians possess now a ready means of detecting glass liable to deterioration and have no difficulty in securing suitable glasses.

III. The third section, comprising geometric and nautical instruments, includes also those instruments which form a connecting link between astronomy proper and the land-surveyor's art, *i. e.*, those astronomical instruments which are employed for geodetic measurements. Many improvements in this group of instruments have emanated from German workshops and have had their origin in the requirements of the International Survey and especially the influence of the Geodetic Institute and its present director, Dr. Helmert. We may here mention the conversion of the friction-rollers of transit instruments into a balance beam, so as to completely compensate the errors of collimation. We may also refer to Repsold's mode of fitting transit instruments so as to neutralize almost entirely the personal equation, and equally important are the improvements in zenith-telescopes and spirit-level testing appliances. The geophysical investigations of the International Survey have given birth to the most sensitive instrument of our times, the horizontal pendulum, which owes its origin and development to German scientists and mechanicians. The study of the movements of the oceans has recently been facilitated by greatly improved instruments, the most perfect of which are those of Seibt-Fuess. Remarkable progress has in late years been made in the construction of surveying instruments. The requirements of surveyors and engineers have reached such a high stage of development that they could not fail to beneficially affect the construction of theodolites, leveling instruments and tacheometers. The manufacture of surveying instruments is carried on in Germany on a very extensive scale, and the reputation of these instruments has obtained for them a wide market all over the world. Considerable improvements have also been made in small compactly built surveying instruments, which have been requisitioned by numerous German explorers. As the natural outcome of the developments of the merchant service and the creation of a powerful navy, considerable attention is paid to the manufacture of nautical instruments. Whereas formerly Germany depended for these accessories of navigation upon other countries, England in particular, at the present time all nautical instruments are manufactured at home equally well, in some respects even better than abroad.

IV. The development of the meteorological instruments and the appliances for measuring temperatures presents a typical illustration of the close connection be-

tween theoretical science and manufacture in Germany. This applies in particular to thermometers. About twenty years ago the manufacture of thermometers had come to a dead stop in Germany, thermometers being then invested with a defect, their liability to periodic changes, which seriously endangered German manufacture. Comprehensive investigations were then carried on by the Normal-Aichungs-Kommission, the Imperial Physical and Technical Institute and the Jena Glass Works, and after much labor brought the desired reward. Chemical analysis in conjunction with carefully managed glass smeltings and practical tests showed that pure potassic and pure sodic glasses possess these defects in the least degree, whereas glasses containing both alkalis are subject to periodic changes to such an extent as to render them useless for thermometric purposes. The last outcome of these investigations was the production, at the Jena Glass Works, of an excellent sodium glass which shows depressions of not more than 0.1° per 100°. Recently a boro-silicate glass has been prepared which shows a maximum depression of only 0.05° and possesses, moreover, the important property of excellently agreeing with the hydrogen thermometer. The advantages which may result from these discoveries to meteorology as well as the physical, chemical and medical sciences, are obvious. The technical arts too have benefited by discovery. With the aid of the new glasses and the invention of a process by which mercury is kept in the thermometer under a pressure of from 20 to 25 atmospheres, thermometers have been constructed for temperatures up to and beyond 550° C., as far as the region of incipient red heat, and reading accurately to $\frac{1}{10}$°. In consequence of these systematic efforts the manufacture of thermometers has reached in Germany an unprecedented level, and now governs the market of the world. German thermometers are purchased everywhere with particular confidence, as they can be supplied with official certificates. The Thermometer Testing Institute of Ilmenau examine annually about 40,000, and 16,000 are annually tested by the Imperial Physical and Technical Institute. German barometers, mercurial as well as aneroid, enjoy a high reputation and are everywhere esteemed for their delicate workmanship and reliability. The aneroid-barometers, which have obtained increased importance through the requirements of explorers, are tested by the Imperial Physical and Technical Institute with respect to their liability to periodic changes. The merits of the German self-registering instruments of the Sprung-Fuess type, thermographs and barographs, anemometers and rain-gauges are so well known that they need no further comment. These excellent instruments are used in all the meteorological observatories of the world. Finally, attention should be drawn to the pyrometers and calorimeters, which have also been considerably improved in recent years.

V. Like the mechanical arts, optical construction has made great and rapid progress in Germany. In this connection it is our gratifying duty to mention the name of Abbe, whose master-mind has had a profound influence upon the development of German optical science and manufacture. Abbe's earliest great merit is the elucidation of the theory of the microscope, by which he has placed microscopical optics upon an entirely new basis. It is also due to his efforts, in conjunction with those of Dr. Schott, the head of the Jena Glass Works, that numerous optically valuable glasses have been rendered available for the purposes of optical construction and that many difficult problems have now been solved. The new Jena phosphate and baryte glasses have led to many improvements in microscopical optics. We need only refer to the

Zeiss Apochromatic objectives, which, in conjunction with the compensating eyepieces, yield a much more perfect correction of the chromatic and spherical aberrations than was previously attainable. We believe that we are not going too far by saying that to Professor Abbe is due the world-wide fame of German microscope construction. This reputation is not limited to the microscope itself, but to all its accessories, and embraces also microtomes, photo-micrographic and projection appliances and, in particular, photographic objectives, the construction of which has undergone wonderful changes since the introduction of the Jena glasses. The enormous exigencies of modern artificial illumination has given rise to many improvements in photometry. In this department the path has been smoothed by the efforts of the Imperial Physical and Technical Institute, and photometers are now made by which the intensity of a luminary can be measured with a degree of accuracy within ½ per cent. The result is that German photometers enjoy a predominant popularity.—Germany, the cradle of spectrum analysis, occupies naturally an important position in the manufacture of spectrum appliances. The construction of these instruments, varying from the largest and finest spectrometers for astronomical, physical and chemical research, to the smallest hand spectroscopes, employs a large number of establishments. The same applies to the manufacture of polariscopic appliances, which have a wide reputation and command a particularly large market in the sugar trade.—No less importance attaches to the optical measuring instruments designed for the special requirements of physicists, chemists, mineralogists, etc., which are made with astronomical precision, so as to satisfy the highest exigencies of modern research. Among these we may mention the crystaloptic instruments and those for studying the theory of the nature of light.—In the construction of telescopes Germany has, in addition to general improvements, achieved a triumph, which has given her a great advantage. We are referring to the new form of binocular telescopes, in which, by the interposition of prisms, the dimensions of terrestrial telescopes are reduced to their lowest limits, while, at the same time, the defining power, light-gathering power and the stereoscopic effect are greatly increased as compared with the old types. The invention of these telescopes has created a wide demand in the army and navy. Very considerable, too, is the industry in optical auxiliaries, prisms, quartz and calc-spar preparations, etc., in which Germany excels both in quality and productiveness.

VI. The manufacture of electrical measuring instruments for scientific purposes has, in Germany, kept pace with the great strides made in electrical engineering. A number of prominent firms apply themselves to this technical branch and have made themselves a good name. This industry has likewise profited by the fundamental labors of the Imperial Physical and Technical Institute, in particular by the establishment of standards and by important investigations. We may here mention the introduction of new resistance materials, called manganine and constantan, which are not affected by changes of temperature and are now introduced by nearly all German firms occupied with the manufacture of electrical measuring instruments. Mention should also be made of the work accomplished in standard cells, which facilitate the application of the so-called methods of compensation for accurately measuring the strength and E.M.F. of electrical currents. This is, therefore, another department where the influence of scientific research has been felt in practical manufacture.

VII. Electro-medical appliances are also

made in Germany and exported abroad in very large numbers. The growing application of the electric current as a curative agent in operations and for the illumination of internal cavities of the human body has caused this department of industry to develop considerably both technically and commercially. To this group of appliances belong the various kinds of Röntgen ray apparatus, which are made and exported in stupendous numbers. Great importance attaches also to the manufacture of physiological and biological instruments, which engages the attention of several prominent firms.

VIII. The manufacture of educational appliances has grown in proportion to the development of the methods of practical demonstration in elementary as well as intermediate schools and technical colleges. The German output of educational appliances has at present reached a truly astounding magnitude. This is mainly due to their cheapness, simplicity and their suitable size. The laboratory appliances required for scientific investigations comprise naturally the finest and costliest instruments made.

IX. The manufacture of drawing and calculating instruments employs a large number of German mechanicians. Excellent drawing instruments and other appliances for drawing, cartography, etc., are exported to all parts of the world. German mechanicians have likewise succeeded in considerably improving Thomas's old calculating machine.

X. In addition to purely scientific instruments, a very large number of appliances are in constant requisition for special industrial purposes, and many a mechanician finds constant employment in this department. Besides, much thought and skill is brought to bear upon the needs of mechanical workshops. Formerly every mechanician made his own tools, and in many instances this is still done. Many changes have, however, been wrought in this respect by the influence of the American system of manufacture, in which, it should be added, Germans have a considerable share. Prominent mechanicians and engineers began to devote themselves more or less exclusively to the manufacture of special tools for philosophical instrument-making, and now form an important independent branch of industry.

In conclusion, we have to draw attention to the separate exhibition of the Imperial Physical and Technical Institute, which could not be mortised into the general plan of the Joint Exhibition. The aims of this Institute, the greatest of its kind in the world, have already been explained. The exhibits of the Institute serve to illustrate in a concise form several spheres of its activity.

The commercial importance of the mechanical and optical trade of Germany is commensurate with its reputation, as will readily be seen from the following table showing the export of scientific instruments during 1898:

	Net weight kilos.	Value in Marks.
Astronomical, optical mathematical, physical and electrical instruments	218,900	8,975,000
Raw optical glass (flint and crown)	124,900	625,000
Optical glasses (spectacles, reading-glasses, stereoscope glasses)	224,200	3,139,000
Terrestrial telescopes, field-glasses, opera-glasses, m'ntd spectacles, etc.	33,900	1,526,000
Total	601,900	14,265,000

The export has been trebled within ten years!

Another measure of the magnitude of the mechanical and optical trade of Germany may be obtained from the number of manufacturing establishments and their employés.

These are at present as follows:

Nature of manufacture.	Number of establishments.	Number of persons employed.
Astronomical, optical, mathematical, physical and electrical instruments	500	9,200
Glass-blowing, glass instruments, glass thermometers	125	1,773
Optical instruments, spectacles, reading-glasses	165	2,652
Total	790	13,625

THE FIRST SPECIES NAMED AS THE TYPE OF THE GENUS.

IN the suggestive article on 'The Method of Types in Botanical Nomenclature,' by Mr. O. F. Cook, published in SCIENCE of September 28, 1900, is an admirable statement of the meaning of type in biological taxonomy.

A species 'is a coherent or continuous group of organisms.' Its type is the first individual on which the specific name was bestowed. The type-specimen has an especial value in fixing the name and meaning of the species.

In like manner 'a genus of organisms is a species without close affinities or a group of mutually related species.' In other words, it too 'is a coherent or continuous group of organisms.' It is essential to its definition that some one of its species should constitute its type, to which the generic name should be inseparably attached. The large genera of earlier writers, subdivisions of their artificial orders, rather than groups of species, must become each associated around a special type before they can enter into modern conceptions of nomenclature.

The first essential in nomenclature is fixity. To establish permanence we must eliminate all elements of personal choice. The fixity of specific names through the law of priority is now fairly well established. Generic names are not yet similarly fixed. The method of changing the conception of an old genus from that of a mere subdivision of a higher group to that of a group of related species associated about a type species has not yet been well determined. In nomenclature, a genus must be fixed by its type, which is definite, not by its definition, which may be amended. Some writers have insisted that the first writer who subdivides a genus has the right and the duty to fix its type. Others maintain that the type must always be fixed by the process of elimination. In this process authors who eliminated unconsciously or in ignorance must be considered, as well as those who attempted to limit and define the generic parts in a group of family rank, called by its author a genus.

The method of elimination is now generally approved, but there is great variation in the application of it. Its great defect lies in the necessary uncertainty of its definition. Too often different assumptions or different points of view give different results. Any result may be vitiated by the discovery of some note or discussion—useless in itself, which may have been overlooked at the time of the first attempt at finding the type.

Inasmuch as the thought of type is inseparable in modern taxonomy from the idea of genus or species, it is most desirable to find some way of fixing the type of an author through the words of the author himself—not trusting to the mazes of subsequent delimitation and elimination.

The most convenient and most logical method of doing this, as well as the one most practically convenient, is to fix a group name to the first individual or the first species to which the name was tenably applied. If based on specimens, the species would rest with the individual actually in hand for description. If based on a series of previous records, the one of these standing first in the list of synonyms should be the type.

In the case of the genus, if no type, central species or 'chef de file' is indicated by

the author, the first species referred to the genus by the author or by any subsequent writer ought to be taken as the type. This would ensure fixity. It has no element of injustice. The genus should stand or fall on the first species mentioned.

As Mr. Cook observes: "The selection of the first species as the type would result in no complications by reason of the Linnæan arrangement of species, and it may be confidently expected that the uniform application of such a rule would necessitate far fewer changes than would the method of elimination whereby the doubtful or unidentifiable species are often the only residue on which time-honored names could be maintained."

The practicability of this rule must be tested by different taxonomists, each by its effects in his own field of work. In ichthyology it would bring an enormous gain in giving fixity of generic nomenclature which can be attained in no other way. The process of elimination has never been consistently followed, nor can the process be so defined that it can yield fixed results in the case of the complex genera of the last century. The practice of taking the first species named as the generic type has been adopted and continuously followed by the most voluminous writer on fishes, Dr. Pieter van Bleeker, and others have used it as a guide in cases of doubt.

The really strong and perhaps conclusive argument against it is derived from its effect on the genera of Linnæus. In general, Linnæus placed his central species or type in the midst of a genus, leaving the aberrant species at either end of the list. Cuvier followed the plan of giving a full description of a type species or 'chef de file,' letting the less known or less important species follow after it. It was not until about the beginning of the nineteenth century that the thought of a type species came to be associated with the genus.

Should we adopt the 'first species type' rule in relation to genera, the following changes would result from its application to the tenth edition of the Systema Naturæ.

Raja would be transferred to *Tetronarce* (Torpedo).
Squalus would remain with *Acanthias*.
Gadus would replace *Melanogrammus*.
Echeneis would replace *Remora*.
Cottus would replace *Agonus*.
Zeus would replace *Selene*.
Pleuronectes would replace *Achirus*.
Chætodon would replace *Zanclus*.
Labrus would replace *Sparisoma*.
Trigla would replace *Peristethus*.
Cobitis would replace *Anableps*.
Silurus would replace *Parasilurus*.
Esox would replace *Spyræna*.
Polynemus would replace *Pentanemus*.
Cyprinus would replace *Barbus*.
Ostracion would replace *Lactophrys*.
Tetraodon would replace *Spheroides*.
Diodon would replace *Chilomycterus*.
Syngnathus would replace *Typhle*.
Muræna, *Blennius*, *Gobius*, *Sparus*, *Sciæna*, *Perca*, *Gasterosteus*, *Salmo*, and *Clupea* would be unchanged.

These changes in time-honored names are apparently out of the question. In ichthyology the rule, if adopted, must pass by Linnæus to take effect with his successors or perhaps only among writers of this century influenced by the Cuvierian 'chef de file' method or by the modern conception of type.

The possibility of this suggestion is worth considering. It is stated on high authority, though I have not yet verified the quotation, that Linnæus somewhere says in effect that the real type of each genus recognized by him is 'the best known European or officinal species contained in it.' It would be relatively easy to determine the species worthy of this distinction. It would be easy to put ourselves in Linnæus' place in this regard. Then taking the Systema Naturæ as a starting point, it would be possible and just to hold each genus of each author, where no type is explicitly indicated, rigidly to the first species named under it. By this ruling it would be possible to avoid

certain very undesirable changes in Linnæan nomenclature, unavoidable under the rule of elimination. Among these are the following:

Esox for *Belone*.
Syngnathus for *Nerophis*.
Polynemus for *Pentanemus*.

Meanwhile the confused generic messes of Bloch, Lacépède, Swainson, Rafinesque and others, could be definitely crystallized and made to stand or fall on the generic distinction of the first species named.

The general adoption of such means of determining types would go a long way toward stability of nomenclature, and it is possible to use it in case we may be permitted to apply another method to the genera of Linnæus. If no exceptions can be properly made, then, for one, the writer would prefer its rigid application to all authors, Linnæus included, to the present state of confusion.

In any event, the suggestion of Mr. Cook merits serious consideration and reconsideration, for it has been several times rejected by zoologists.

DAVID STARR JORDAN.

ADDRESS OF THE PRESIDENT OF THE SECTION OF GEOLOGY OF THE BRITISH ASSOCIATION.

II.

OBSCURE CHAPTER IN THE EARTH'S HISTORY.

BEFORE discussing the validity of the argument on which this last result depends, let us consider how far it harmonizes with previous ones. It is consistent with Lord Kelvin's and Professor Darwin's, but how does it accord with Professor Joly's? Supposing we reduce his estimate to fifty-five millions; what was the earth doing during the interval between the period of fifty-five millions of years ago and that of only twenty-six and one-half millions of years ago, when, it is presumed, sedimentary rocks commenced to be formed? Hitherto we have been able to reason on probabilities; now we enter the dreary region of possibilities, and open that obscure chapter in the history of the earth previously hinted at. For there are many possible answers to this question. In the first place, the evidence of the stratified rocks may have been wrongly interpreted, and two or three times the amount of time we have demanded may have been consumed in their formation. This is a very obvious possibility, yet again our estimate concerning these rocks may be correct, but we may have erroneously omitted to take into account certain portions of the Archæan complex, which may represent primitive sedimentary rocks formed under exceptional conditions, and subsequently transformed under the influence of the internal heat of the earth. This, I think, would be Professor Bonney's view. Finally, Lord Kelvin has argued that the life of the sun as a luminous star is even more briefly limited than that of our oceans. In such a case, if our oceans were formed fifty-five millions of years ago, it is possible that after a short existence as almost boiling water they grew colder and colder, till they became covered with thick ice, and moved only in obedience to the tides. The earth, frozen and dark, except for the red glow of her volcanoes, waited the coming of the sun, and it was not till his growing splendor had banished the long night that the cheerful sound of running waters was heard again in our midst. Then the work of denudation and deposition seriously recommenced, not to cease till the life of the sun is spent. Thus the thickness of the stratified series may be a measure rather of the duration of sunlight than of the period which has elapsed since the first formation of the ocean. It may have been so—we cannot tell—but it may be fairly urged that we know less of the origin, history, and constitution of the sun than of the earth itself, and that, for aught we can

say to the contrary, the sun may have been shining on the just-formed ocean as cheerfully as he shines to-day.

TIME REQUIRED FOR THE EVOLUTION OF THE LIVING WORLD.

But, it will be asked, how far does a period of twenty-six millions satisfy the demands of biology? Speaking only for myself, although I am aware that eminent biologists are not wanting who share this opinion, I answer, Amply. But, it will be exclaimed, surely there are 'comparisons in things.' Look at Egypt, where more than 4,000 years since the same species of man and animals lived and flourished as to-day. Examine the frescoes and study the living procession of familiar forms they so faithfully portray, and then tell us, how comes it about that from changes so slow as to be inappreciable in the lapse of forty centuries you propose to build up the whole organic world in the course of a mere twenty-six millions of years? To all which we might reply that even changeless Egypt presents us with at least one change—the features of the ruling race are to-day not quite the same as those of the Pharaohs. But putting this on one side, the admitted constancy in some few common forms proves very little, for so long as the environment remains the same natural selection will conserve the type, and, so far as we are able to judge, conditions in Egypt have remained remarkably constant for a long period.

Change the conditions, and the resulting modification of the species becomes manifest enough; and in this connection it is only necessary to recall the remarkable mutations observed and recorded by Professor Weldon in the case of the crabs in Plymouth Harbor. In response to increasing turbidity of the sea water these crabs have undergone or are undergoing a change in the relative dimensions of the carapace, which is persistent, in one direction, and rapid enough to be determined by measurements made at intervals of a few years.

Again, animals do not all change their characters at the same rate: some are stable, in spite of changing conditions, and these have been cited to prove that none of the periods we look upon as probable, not twenty-five, not a hundred millions of years, scarce any period short of eternity, is sufficient to account for the evolution of the living world. If the little tongue-shell, *Lingula*, has endured with next to no perceptible change from the Cambrian down to the present day, how long, it is sometimes inquired, would it require for the evolution of the rest of the animal kingdom? The reply is simple: the cases are dissimilar, and the same record which assures us of the persistency of the *Lingula* tells us in language equally emphatic of the course of evolution which has led from the lower organisms upwards to man. In recent and Pleistocene deposits the relics of man are plentiful: in the latest Pliocene they have disappeared, and we encounter the remarkable form *Pithecanthropus;* as we descend into the Tertiary systems the higher mammals are met with, always sinking lower and lower in the scale of organization as they occur deeper in the series, till in the Mesozoic deposits they have entirely disappeared, and their place is taken by the lower mammals, a feeble folk, offering little promise of the future they were to inherit. Still lower, and even these are gone; and in the Permian we encounter reptiles and the ancestors of reptiles, probably ancestors of mammals too; then into the Carboniferous, where we find amphibians, but no true reptiles; and next into the Devonian, where fish predominate, after making their earliest appearance at the close of the Silurian times; thence downwards, and the vertebrata are no more found—we trace the evolution of the invertebrata alone. Thus the orderly proces-

sion of organic forms follows in precisely the true phylogenetic sequence; invertebrata first, then vertebrata, at first fish, then amphibia, next reptiles, soon after mammals, of the lowlier kinds first, of the higher later, and these in increasing complexity of structure till we finally arrive at man himself. While the living world was thus unfolding into new and nobler forms, the immutable *Lingula* simply perpetuated its kind. To select it, or other species equally sluggish, as the sole measure of the rate of biologic change would seem as strange a proceeding as to confound the swiftness of a river with the stagnation of the pools that lie beside its banks. It is occasionally objected that the story we have drawn from the paleontological record is mere myth or is founded only on negative evidence. Cavils of this kind prove a double misapprehension, partly as to the facts, partly as to the value of negative evidence, which may be as good in its way as any other kind of evidence.

Geologists are not unaware of the pitfalls which beset negative evidence, and they do not conclude from the absence of fossils in the rocks which underlie the Cambrian that pre-Cambrian periods were devoid of life; on the contrary, they are fully persuaded that the seas of those times were teeming with a rich variety of invertebrate forms. How is it that, with the exception of some few species found in beds immediately underlying the Cambrian, these have left behind no vestige of their existence? The explanation does not lie in the nature of the sediments, which are not unfitted for the preservation of fossils, nor in the composition of the then existing sea water, which may have contained quite as much calcium carbonate as occurs in our present oceans; and the only plausible supposition would appear to be that the organisms of that time had not passed beyond the stage now represented by the larvæ of existing invertebrata, and consequently were either unprovided with skeletons, or at all events with skeletons durable enough for preservation. If so, the history of the earlier stages of the evolution of the invertebrata will receive no light from paleontology and no direct answer can be expected to the question whether, eighteen or nineteen millions of years being taken as sufficient for the evolution of the vertebrata, the remaining available eight millions would provide for that of the invertebrate classes which are represented in the lowest Cambrian deposits.' On *à priori* grounds there would appear to be no reason why it should not. If two millions of years afforded time enough for the conversion of fish into amphibians, a similar period should suffice for the evolution of trilobites from annelids, or of annelids from trochospheres. The step from gastrulas to trochospheres might be accomplished in another two millions, and two millions more would take us from gastrulas through morulas to protozoa.

As things stand, biologists can have nothing to say either for or against such a conclusion; they are not at present in a position to offer independent evidence; nor can they hope to be so until they have vastly extended those promising investigations which they are only now beginning to make into the rate of the variation of species.

UNEXPECTED ABSENCE OF THERMAL METAMORPHOSIS IN ANCIENT ROCKS.

Two difficulties now remain for discussion: one based on theories of mountain chains, the other on the unaltered state of some ancient sediments. The latter may be taken first. Professor van Hise writes as follows regarding the pre-Cambrian rocks of the Lake Superior district: "The Penokee series furnishes an instructive lesson as to the depth to which rocks may be buried and yet remain but slightly affected

by metamorphosis. The series itself is 14,000 feet thick. It was covered before being upturned with a great thickness of Keweenaw rock. This series of the Montreal River is estimated to be 50,000 feet thick. Adding to this the known thickness of the Penokee series, we have a thickness of 64,000 feet. * * * The Penokee rocks were then buried to a great depth, the exact amount depending upon their horizon and upon the stage in Keweenaw time, when the tilting and erosion, which brought them to the surface, commenced.

"That the synclinal trough of Lake Superior began to form before the end of the Keweenaw period, and consequently that the Penokee rocks were not buried under the full succession, is more than probable. However, they must have been buried to a great depth—at least several miles—and thus subjected to high pressure and temperature, notwithstanding which they are comparatively unaltered." *

I select this example because it is one of the best instances of a difficulty that occurs more than once in considering the history of sedimentary rocks. On the supposition that the rate of increment of temperature with descent is 1° F. for every 84 feet, or 1° C. for every 150 feet, and that it was no greater during these early Penokee times, then at a depth of 50,000 feet the Penokee rocks would attain a temperature of nearly 333° C.; and since water begins to exert powerful chemical action at 180° C. they should, on the theory of a solid cooling globe, have suffered a metamorphosis sufficient to obscure their resemblance to sedimentary rocks. Either then the accepted rate of downward increase of temperature is erroneous, or the Penokee rocks were never depressed, in the place where they are exposed to observation, to a depth of 50,000 feet. Let us consider each alternative, and in the first place let us apply the rate of temperature increment determined by Professor Agassiz in this very Lake Superior district: it is 1° C. for every 402 feet, and twenty-five millions of years ago, or about the time when we may suppose the Penokee rocks were being formed, it would be 1° C. for every 305.5 feet, with a resulting temperature, at a depth of 50,000 feet, of 163° C. only. Thus the admission of a very low rate of temperature increment would meet the difficulty; but on the other hand, it would involve a period of several hundreds of millions of years for the age of the 'consistentior status,' and thus greatly exceed Professor Joly's maximum estimate of the age of the oceans. We may therefore turn to the second alternative. As regards this, it is by no means certain that the exposed portion of the Penokee series ever was depressed 50,000 feet; the beds lie in a synclinal the base of which indeed may have sunk to this extent, and entered a region of metamorphosis; but the only part of the system that lies exposed to view is the upturned margin of the synclinal, and as to this it would seem impossible to make any positive assertion as to the depth to which it may or may not have been depressed. To keep an open mind on the question seems our only course for the present, but difficulties like this offer a promising field for investigation.

**Tenth Annual Report U. S. Geol. Survey*, 1888–89, p. 457.

THE FORMATION OF MOUNTAIN RANGES.

It is frequently alleged that mountain chains cannot be explained on the hypothesis of a solid earth cooling under the conditions and for the period we have supposed. This is a question well worthy of consideration, and we may first endeavor to picture to ourselves the conditions under which mountain chains arise. The floor of the ocean lies at an average depth of 2,000 fathoms below the land, and is maintained at a constant temperature, closely approach-

ing 0° C., by the passage over it of cold water creeping from the polar regions. The average temperature of the surface of the land is above zero, but we can afford to disregard the difference in temperature between it and the ocean floor, and may take them both at zero. Consider next the increase of temperature with descent, which occurs beneath the continents: at a depth of 13,000 feet, or at same depth as the ocean floor, a temperature of 87° C. will be reached on the supposition that the rate of increase is 1° C. for 150 feet, while with the usually accepted rate of 1° C. for 108 feet it would be 120° C. But at this depth the ocean floor, which is on the same spherical surface, is at 0° C. Thus surfaces of equal temperature within the earth's crust will not be spherical, but will rise or fall beneath an imaginary spherical or spheroidal surface, according as they occur beneath the continents or the oceans. No doubt at some depth within the earth the departure of isothermal surfaces from a spheroidal form will disappear; but considering the great breadth both of continents and oceans, this depth must be considerable, possibly even forty or fifty miles. Thus the subcontinental excess of temperature may make itself felt in regions where the rocks still retain a high temperature, and are probably not far removed from the critical fusion point. The effect will be to render the continents mobile as regards the ocean floor; or *vice versa*, the ocean floor will be stable compared with the continental masses. Next it may be observed that the continents pass into the bed of the ocean by a somewhat rapid flexure, and that it is over this area of flexure that the sediments denuded from the land are deposited. Under its load of sediment the sea floor sinks down, subsiding slowly, at about the same rate as the thickness of sediment increases; and whether as a consequence or a cause, or both, the flexure marking the boundary of land and sea becomes more pronounced. A compensating movement occurs within the earth's crust, and solid material may flow from under the subsiding area in the direction of least resistance, possibly towards the land. At length, when some thirty or forty thousand feet of sediment have accumulated in a basin-like form, or, according to our reckoning, after the lapse of three or four millions of years, the downward movement ceases, and the mass of sediment is subjected to powerful lateral compression, which, bringing its borders into closer proximity by some ten or thirty miles, causes it to rise in great folds high into the air as a mountain chain.

It is this last phase in the history of mountain making which has given geologists more cause for painful thought than probably any other branch of their subject, not excluding even the age of the earth. It was at first imagined that during the flow of time the interior of the earth lost so much heat, and suffered so much contraction in consequence, that the exterior, in adapting itself to the shrunken body, was compelled to fit it like a wrinkled garment. This theory, indeed, enjoyed a happy existence till it fell into the hands of mathematicians, when it fared very badly, and now lies in a pitiable condition neglected of its friends.*

For it seemed proved to demonstration that the contraction consequent on cooling was wholly, even ridiculously, inadequate to explain the wrinkling. But when we summon up courage to inquire into the data on which the mathematical arguments are based, we find that they include several assumptions, the truth of which is by no means self-evident. Thus it has been assumed that the rate at which the fusion point rises with increased pressure is constant, and follows the same law as is deduced

* With some exceptions, notably Mr. C. Davison, a consistent supporter of the theory of contraction.

from experiments made under such pressures as we can command in our laboratories down to the very center of the earth, where the pressures are of an altogether different order of magnitude; so with a still more important coefficient, that of expansion, our knowledge of this quantity is founded on the behavior of rocks heated under ordinary atmospheric pressure, and it is assumed that the same coefficient as is thus obtained may be safely applied to material which is kept solid, possibly near the critical point, under the tremendous pressure of the depths of the crust. To this last assumption we owe the terrible bogies that have been conjured out of 'the level of no strain.' The depth of this, as calculated by the Rev. O. Fisher, is so trifling that it would be passed through by all very deep mines. Mr. C. Davison, however, has shown that it will lie considerably deeper, if the known increase of the coefficient of expansion with rise of temperature be taken into account. It is possible, it is even likely, that the coefficient of expansion becomes vastly greater when regions are entered where the rocks are compelled into the solid state by pressure. So little do we actually know of the behavior of rock under these conditions that the geologist would seem to be left very much to his own devices; but it would seem there is one temptation he must resist—he must not take refuge in the hypothesis of a liquid interior.

We shall boldly assume that the contraction at some unknown depth in the interior of the earth is sufficient to afford the explanation we seek. The course of events may then proceed as follows: The contraction of the interior of the earth, consequent on its loss of heat, causes the crust to fall upon it in folds, which rise over the continents and sink under the oceans, and the flexure of the area of sedimentation is partly a consequence of this folding, partly of overloading. By the time a depression of some 30,000 or 40,000 feet has occurred along the ocean border the relation between continents and oceans has become unstable, and readjustment takes place, probably by a giving way of the continents, and chiefly along the zone of greatest weakness—*i. e.*, the area of sedimentation, which thus becomes the zone of mountain building. It may be observed that at great depths readjustment will be produced by a slow flowing of solid rock, and it is only comparatively near the surface, five or ten miles at the most below, that failure of support can lead to sudden fracture and collapse; hence the comparatively superficial origin of earthquakes.

Given a sufficiently large coefficient of expansion—and there is much to suggest its existence — and all the phenomena of mountain ranges become explicable; they began to present an appearance that invites mathematical treatment; they inspire us with the hope that from a knowledge of the height and dimensions of a continent and its relations to the bordering ocean we may be able to predict when and where a mountain chain should arise, and the theory which explains them promises to guide us to an interpretation of those world-wide unconformities which Suess can only account for by a transgression of the sea. Finally it relieves us of the difficulty presented by mountain formation in regard to the estimated duration of geological time.

INFLUENCE OF VARIATIONS IN THE ECCENTRICITY OF THE EARTH'S ORBIT.

This may perhaps be the place to notice a highly interesting speculation which we owe to Professor Blytt, who has attempted to establish a connection between periods of readjustment of the earth's crust and variations in the eccentricity of the earth's orbit. Without entering into any discussion of Professor Blytt's methods, we may

offer a comparison of his results with those that follow from our rough estimate of one foot of sediment accumulated in a century.

TABLE SHOWING THE TIME THAT HAS ELAPSED SINCE THE BEGINNING OF THE SYSTEMS IN THE FIRST COLUMN, AS RECKONED FROM THICKNESS OF SEDIMENT IN THE SECOND COLUMN, AND BY PROFESSOR BLYTT IN THE THIRD.

	Years.	Years.
Eocene	4,200,000	3,250,000
Oliogocene	3,000,000	1,810,000
Miocene	1,800,000	1,160,000
Pliocene	900,000	700,000
Pleistocene	400,000	350,000

It is now time to return to the task, too long postponed, of discussing the data from which we have been led to conclude that a probable rate at which the sediments have accumulated in places where they attain their maximum thickness is one foot per century.

RATE OF DEPOSITION OF SEDIMENT.

We owe to Sir Archibald Geikie a most instructive method of estimating the existing rate at which our continents and islands are being washed into the sea by the action of rain and rivers: by this we find that the present land surface is being reduced in height to the extent of an average of 1/2400 foot yearly (according to Professor Penck 1/3600 foot). If the material removed from the land were uniformly distributed over an area equal to that from which it had been derived it would form a layer of rock 1/2400 foot thick yearly—*i. e.*, the rates of denudation and deposition would be identical. But the two areas, that of denudation and that of deposition, are seldom or never equal, the latter, as a rule, being much the smaller. Thus the area of that part of North America which drains into the Gulf of Mexico measures 1,800,000 square miles; the area over which its sediments are deposited is, so far as I can gather from Professor Agassiz's statements, less then 180,000 square miles; while Mr. McGee estimates it at only 100,000 square miles. Using the largest number, the area of deposition is found to measure one-tenth the area of denudation; the average rate of deposition will therefore be ten times as great as the rate of denudation, or 1/240 foot may be supposed to be uniformly distributed over the area of sedimentation in the course of a year. But the thickness by which we have measured the strata of our geological systems is not an average, but a maximum thickness; we have therefore to obtain an estimate of the maximum rate of deposition. If we assume the deposited sediments to be arranged somewhat after the fashion of a wedge with the thin end seawards, then twice the average would give us the maximum rate of deposition; this would be one foot in 120 years. But the sheets of deposited sediment are not merely thicker towards the land, thinner towards the sea, they also increase in thickness towards the rivers in which they have their source, so that a very obtuse-angled cone, or, better, the downturned bowl of a spoon, would more nearly represent their form. This form tends to disappear under the action of waves and currents, but a limit is set to this disturbing influence by the subsidence which marks the region opposite the mouth of a large river. By this the strata are gradually let downwards, so that they come to assume the form of the bowl of a spoon turned upwards. Thus a further correction is necessary if we are to arrive at a fair estimate of the maximum rate of deposition. Considering the very rapid rate at which our ancient systems diminish in thickness when traced in all directions from the localities where they attain their maximum, it would appear that this correction must be a large one. If we reduce our already corrected estimate by one-fifth, we arrive at a rate of one foot of sediment deposited in a century.

No doubt this value is often exceeded; thus in the case of the Mississippi River

the bar of the southwest pass advanced between the years 1838 and 1874 a distance of over two miles, covering an area 2.2 miles in width with a deposit of sediment 80 feet in thickness; outside the bar, where the sea is 250 feet in depth, sediment accumulates, according to Messrs. Humphreys and Abbot, at a rate of two feet yearly. It is quite possible, indeed it is very likely, that some of our ancient strata have been formed with corresponding rapidity. No gravel of coarse sand is deposited over the Mississippi delta; such material is not carried further seawards than New Orleans. Thus the vast sheets of conglomerate and sandstone which contribute so largely to some of our ancient systems, such as the Cambrian, Old Red Sandstone, Millstone Grit, and Coal Measures, must have accumulated under very different conditions, conditions for which it is not easy to find a parallel; but in any case these deposits afford evidence of very rapid accumulation.

These considerations will not tempt us, however, to modify our estimate of one foot in a century; for though in some cases this rate may have been exceeded, in others it may not have been nearly attained.

Closely connected with the rate of deposition is that of the changing level of land and sea; in some cases, as in the Wealden delta, subsidence and deposition appear to have proceeded with equal steps, so that we might regard them as transposable terms. It would therefore prove of great assistance if we could determine the average rate at which movements of the ground are proceeding; it might naturally be expected that the accurate records kept by tidal gauges in various parts of the world would afford us some information on this subject; and no doubt they would, were it not for the singular misbehavior of the sea, which does not maintain a constant level, its fluctuations being due, according to Professor Darwin, to the irregular melting of ice in the polar regions. Of more immediate application are the results of Herr L. Holmström's observations in Scandinavia, which prove an average rise of the peninsula at the rate of three feet in a century to be still in progress; and Mr. G. K. Gilbert's measurements in the Great Lake district of North America, which indicate a tilting of the continent at the rate of three inches per hundred miles per century. But while measurements like these may furnish us with some notion of the sort of speed of these changes, they are not sufficient even to suggest an average; for this we must be content to wait till sufficient tidal observations have accumulated and the disturbing effect of the inconstancy of the sea level eliminated.

It may be objected that in framing our estimate we have taken into account mechanical sediments only, and ignored others of equal importance, such as limestone and coal. With regard to limestone, its thickness in regions where systems attain their maximum may be taken as negligible; nor is the formation of limestone necessarily a slow process. The successful experiments of Dr. Allan, cited by Darwin, prove that reef-building corals may grow at the astonishing rate of six feet in height per annum.

In respect of coal there is much to suggest that its growth was rapid. The carboniferous period well deserves its name, for never before, never since, have Carbonaceous deposits accumulated to such a remarkable thickness or over such wide areas of the earth's surface. The explanation is doubtless partly to be found in favorable climatal conditions, but also, I think, in the youthful energy of a new and overmastering type of vegetation, which then for the first time acquired the dominion of the land. If we turn to our modern peat-bogs, the only Carbonaceous growths available for comparison, we find from data given by Sir A. Geikie that a fairly average rate

of increase is six feet in a century, which might perhaps correspond to one foot of coal in the same period.

The rate of deposition has been taken as uniform through the whole period of time recorded by stratified rocks; but lest it should be supposed that this involves a tacit admission of uniformity, I hasten to explain that in this matter we have no choice; we may feel convinced that the rate has varied from time to time, but in what direction, or to what extent, it is impossible to conjecture. That the sun was once much hotter is probable, but equally so that at an earlier period it was much colder; and even if in its youth all the activities of our planet were enhanced, this fact might not affect the maximum thickness of deposits. An increase in the radiation of the sun, while it would stimulate all the powers of subaerial denudation, would also produce stronger winds and marine currents; stronger currents would also result from the greater magnitude and frequency of the tides, and thus while larger quantities of sediment might be delivered into the sea, they would be distributed over wider areas, and the difference between the maximum and average thickness of deposits would consequently be diminished. Indications of such a wider distribution may perhaps be recognized in the Paleozoic systems. Thus we are compelled to treat our rate of deposition as uniform, notwithstanding the serious error this may involve.

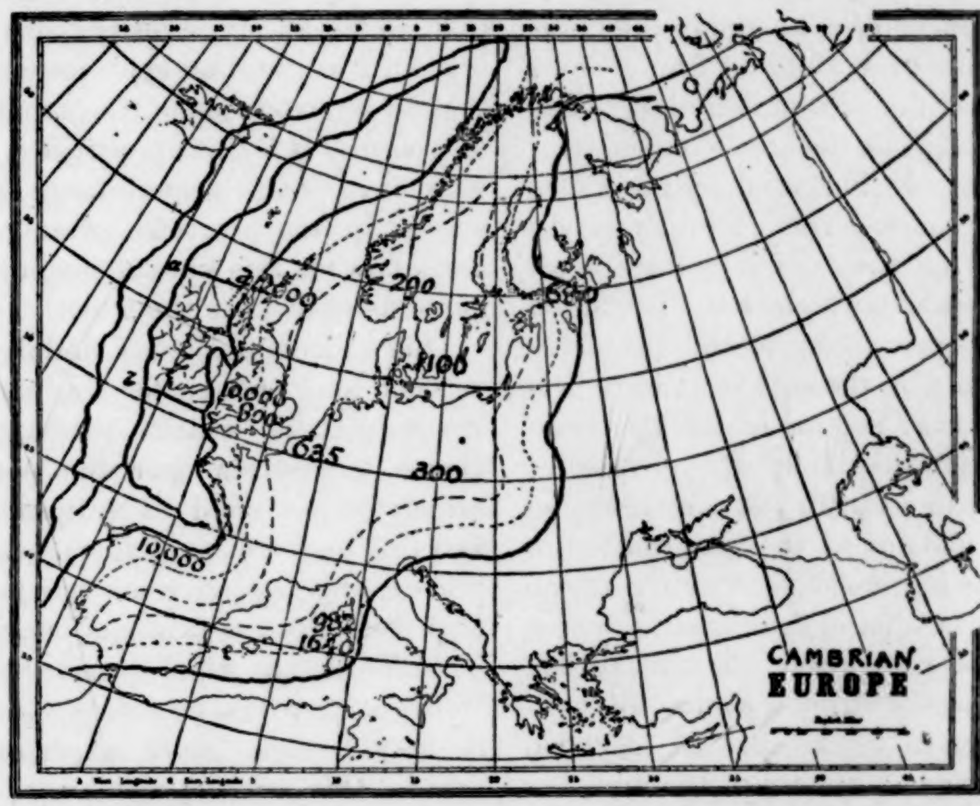

FIG. 2.—Chart of the distribution of land and sea, and of the thickness of deposits of the Cambrian system. The dotted lines indicate distances of 100 and 200 miles from the shore.

The reasonableness of our estimate will perhaps best appear from a few applications. Fig. 2 is a chart, based on a map by De Lapparent, representing the distribution of land and sea over the European area during the Cambrian period. The strata of this system attain their maximum thickness of 12,000 feet in Merionethshire, Wales; they rapidly thin out northwards, and are absent in Anglesey; scarcely less rapidly towards Shropshire, where they are 3,000 feet

thick; still a little less rapidly towards the Malverns, where they are only 800 feet thick; and most slowly towards St. David's Head, where they are 7,400 feet thick. The Cambrian rocks of Wales were in all probability the deposits of a river system which drained some vanished land once situated to the west. How great was the extent of this land none can say; some geologists imagine it to have obliterated the whole or greater part of the North Atlantic Ocean. For my part, I am content with a somewhat large island. What area of this island, we may ask, would suffice to supply the Cambrian sediments of Wales and Shropshire? Admitting that the area of denudation was ten times as large as the area of deposition, its dimensions are indicated by the figure *a b c d* on the chart. This evidently leaves room enough on the island to furnish all the other deposits which are distributed along the western shores of the Cambrian sea, while those on the east are amply provided for by that portion of the European continent which then stood above water.

If one foot in a century be a quantity so small as to disappoint the imagination of its accustomed exercise, let us turn to the Cambrian succession of Scandinavia, where all the zones recognized in the British series are represented by a column of sediment 290 feet in thickness. If 1,600,000 years be a correct estimate of the duration of Cambrian time, then each foot of the Scandinavian strata must have occupied 5,513 years in its formation. Are these figures sufficiently inconceivable?

In the succeeding system, that of the Ordovician, the maximum thickness is 17,000 feet. Its deposits are distributed over a wider area than the Cambrian, but they also occupied longer time in their formation; hence the area from which they were derived need not necessarily have been larger than that of the preceding period.

Great changes in the geography of our area ushered in the Silurian system: its maximum thickness is found over the Lake district, and amounts to 15,000 feet; but in the little island of Gothland, where all the subdivisions of the system, from the Landovery to the Upper Ludlow, occur in complete sequence, the thickness is only 208 feet. In Gothland, therefore, according to our computation, the rate of accumulation was one foot in 7,211 years.

With this example we must conclude, merely adding that the same story is told by other systems and other countries, and that, so far as my investigations have extended, I can find no evidence which would suggest an extension of the estimate I have proposed. It is but an estimate, and those who have made acquaintance with 'estimates' in the practical affairs of life will know how far this kind of computation may guide us to or from the truth.

This address is already unduly long, and yet not long enough for the magnitude of the subject of which it treats. As we glance backwards over the past we see catastrophism yield to uniformitarianism, and this to evolution, but each as it disappears leaves behind some precious residue of truth. For the future of our science our ambition is that which inspired the closing words of your last President's address, that it may become more experimental and exact. Our present watchword is Evolution. May our next be Measurement and Experiment, Experiment and Measurement.

W. J. Sollas.

THE INTERNATIONAL CONGRESSES OF METEOROLOGY AND AERONAUTICS AT PARIS.

These Congresses were held nearly simultaneously on account of their allied interests. The Meteorological Congress, which began its sessions on September 10th, had the same character as the Congress held during the Paris Exposition of 1889, that is to say,

it was open to all meteorologists, and although the countries participating in the Exposition were invited to send delegates, yet these had no power to pledge their respective countries to any action. More than thirty countries were represented this year at the Congress and about one hundred persons of various nationalities attended its sittings, which, consequently, were more truly international than was the case with any preceding congress. The absence of the Chief of the United States Weather Bureau was much regretted and the United States was represented solely by the officials in charge of the Weather Bureau exhibit at the Exposition and by the writer, who had also been the delegate of the United States in 1889. The place of meeting was again at the rooms of the Société d'Encouragement, outside the Exposition grounds.

M. Mascart, the director of the French Meteorological Office, was chosen president of the Congress, which he directed with his usual ability, being ably seconded by M. Angot as general secretary. Three vice-presidents represented England, Russia and Norway, respectively. At least half of the hundred papers presented were discussed by five standing committees whose sittings were open to any persons interested in the subjects. The most important work of the Congress was performed by these committees, foremost among them being the Aeronautical Commission, presided over by Professor Hergesell, that discussed the results obtained in the exploration of the atmosphere by the international use of balloons and kites, and the improvements that could be effected in instruments and methods. Professor Violle, as president of the Commission on Solar Radiation, summed up the state of the subject and heard several papers. Professor Rücker left the meeting of the British Association to preside over the Commission on Terrestrial Magnetism which had presented to it the work being done by magnetic observatories and surveys throughout the world. The Cloud Commission, the oldest of these committees, has always had at its head the indefatigable Professor Hildebrandsson, who was now able to summarize the results of the cloud measurements that through his efforts had been executed in various parts of the world during the so-called 'international cloud-year.' It was resolved to invite the meteorological observatories to undertake special observations of clouds each month on the days that the international ascents of balloons and kites were made in Europe. Eminently practical was the Commission for Weather Telegraphy, which proposed to accelerate the weather despatches in Europe by introducing the 'circuit system' of the United States, but found it necessary to refer the matter to the International Telegraphic Bureau at Berne. From the scope of these committees it will be seen that comparatively few subjects were left for discussion in the general sessions, which, consequently, had less interest than usual and served mainly to confirm the resolutions of the commissions.

Among the institutions visited, the most interesting was the observatory for dynamic meteorology at Trappes, near Versailles, where M. Teisserenc de Bort maintains an admirably equipped observatory, especially engaged at the present time in investigations of the upper atmosphere. This observatory, designed in general after that at Blue Hill, possesses, besides, means of obtaining temperature data at very high altitudes by the 'ballons-sondes' which are sent up twice a week and carry self-recording instruments to the height of ten miles or more. Owing to the many distractions of Paris, the only general entertainment was the banquet on the Eiffel Tower, and this was notable for the eloquent discourse of M. Leygues, Minister of Public

Instruction, who welcomed the meteorologists assembled from all parts of the globe as engaged in a science that benefits humanity and is independent of nationality. Coincident with the Congress, the International Meteorological Committee held a meeting and filled the vacancies existing in it, caused by the retirement of Dr. Scott, of England, and Professor Tacchini, of Italy, by electing to membership Dr. Shaw and Professor Palazzo, their successors as heads of the meteorological bureaus in their respective countries. Professor Hildebrandsson becomes secretary of the committee, a position long and faithfully filled by Dr. Scott.

The Aëronautical Congress convened on September 17th, the day that the Meteorological Congress adjourned. The general sessions were held at the Astro-physical Observatory at Meudon, but the sections met at the Institute of France in Paris. The committee of organization continued in office, namely M. Janssen as president and M. Triboulet as general secretary. Among the honorary vice-presidents was Professor Langley, who, with the writer, was a delegate of the United States. No other Americans attended the meeting, and the difficulty of getting to Meudon, no doubt, was one reason why so few persons came of the one hundred and fifty enrolled. M. Janssen's address was a masterly *résumé* of the progress of aëronautics since the Congress of 1889, and contained appreciative mention of the exploration of the atmosphere by balloons and kites. In speaking of the future, M. Janssen predicted that the nation which first learned to navigate the air would become supreme, for while the ocean, which has given preeminence to the people using it most, has its boundaries, the atmosphere has none. What then, asked the illustrious orator, will become of national frontiers when the aërial fleets can cross them with impunity? Two important conferences were given by the Renard brothers, the well-known officers in charge of the Central Establishment for Military Aëronautics at Chalais-Meudon. Major Paul Renard described the present state of aëronautics as exemplified at the Exposition. Colonel Charles Renard, who, with Major Krebs as collaborator, constructed at Chalais in 1884 the dirigible balloon named *La France*, the performance of which has never been equaled, gave a critical account of the various attempts to navigate the air by such balloon methods, terminating with the balloons recently constructed by M. Santos-Dumont in Paris and the huge one of Count von Zeppelin on the Lake of Constance. The other lectures were by M. Teisserenc de Bort on the meteorological results at Trappes from 'ballons-sondes' and kites and by the writer on the use of kites at Blue Hill to bring down such data from altitudes of three miles. In Paris special and technical papers were presented to four sections relating to different branches of aëronautics, and at the closing general session these communications were summarized and some resolutions were adopted. An international aëronautical committee was appointed, consisting, besides the officers of the Congress, of ten Frenchmen and ten foreigners, whose duty it is to advance aëronautical work throughout the world. On September 21st a delightful banquet at the Orangerie of the Château of Meudon, where the first balloons were constructed during the Empire, closed the Congress, and predictions were freely made that the conquest of the air was near at hand and that possibly members might come to the next reunion in aërial conveyances.

The noteworthy feature of this meeting, which could hardly be called international, was the demonstration of the practical status of aëronautics in France. Through the courtesy of the Minister of War, the establishment of Chalais was opened to the

public for the first time, permitting the construction and manipulation of the war-balloons to be seen, and what was more interesting to the student, the apparatus employed by Colonel Renard in determining the resistance of the air to various bodies moving through it. At the Park of Vincennes, in connection with the aëronautical section of the Exposition and through the cooperation of the Aëro-Club, balloon races were organized, and each Sunday the novel spectacle was presented of a great number of balloons starting on their journey without delay or difficulty. On one afternoon seventeen balloons rose successively, each aëronaut endeavoring to land as near as possible to some point that he had fixed beforehand. The skill shown in utilizing the prevailing currents and in manipulating the guide-ropes may be inferred from the fact that one aëronaut, after a voyage of thirty miles, landed within half a mile of his goal. The same evening eight more balloons ascended and on the following Sundays there were competitions for height and distance. In the former contest a balloon, filled with 106,000 cubic feet of illuminating-gas and carrying a single aëronaut rose more than 27,000 feet, a height never before attained in France, unless perhaps by the ill-fated *Zenith*, when two of its passengers were asphyxiated. In the final long-distance race, about 1,400 miles were traversed in thirty-seven hours and three of the six balloons landed in Russia. All these voyages, accomplished without accident, tend to popularize ballooning as a sport and to facilitate its practical employment whenever the dirigible balloon shall be realized. As before mentioned, a very interesting attempt to solve this problem is being made at Saint Cloud, near Paris, by M. Santos-Dumont, who sits beneath a cigar-shaped balloon and controls a gasoline engine driving the propeller placed in front. In the trial witnessed of his balloon No. 4 an accident to the rudder made it necessary to hold the balloon captive but, nevertheless, it advanced into a light wind and was easily managed. This balloon will compete for the Deutsch prize of twenty thousand dollars for a voyage to the Eiffel Tower and back, a distance of seven miles, in half an hour. The aëronautical exhibit in the Champ de Mars was chiefly retrospective, but a novelty was the *Avion*, or flying machine of M. Ader, which resembles a gigantic bat and although it has never been tried in the open air yet the ingenious construction of the supporting surfaces and the extreme lightness of the steam-engine rendered it an object of attention. The kite competition at Vincennes, which the writer was called upon to judge, was several times postponed for lack of wind and had little interest, since the cellular kite of M. Lecornu was the only one possessing merit.

The Congresses of Meteorology and Aëronautics in 1900 are especially interesting as affording a general retrospect of the progress made by the twin sciences in the century just closing, and as giving a forecast of their possibilities in the next century, for meteorology and aëronautics are mutually dependent upon each other. The exploration of the air will give a better knowledge of the meteorology of the upper regions and perhaps will result in a more complete utilization of natural forces, such as solar energy and wind. The sea, at present the great medium of international communication, is only navigable on its surface while the aëronaut can use a vast depth of atmosphere and, while oceans separate continents, the atmosphere unites and dominates them. It is certain, therefore, as M. Janssen said, that man will not stop until he has conquered the last domain open to his activity.

A. Lawrence Rotch.

SCIENTIFIC BOOKS.

Die Elemente der Entwickelungslehre des Menschen und der Wirbelthiere. Von OSCAR HERTWIG. Jena, Gustav Fischer. 1900. 8vo. Pp. vi + 406, mit 332 Abbildungen im Text.

This work is an abbreviated reissue of the author's well-known 'Lehrbuch'—the new work being about one-third the size of its parent. There is otherwise exceedingly little change, for there is no important modification of the general plan or of the style of treatment or in the point of view from which the author treats his subject. There has been no effort at all to recast the work so as to render it more suited to the requirements of embryological study in the laboratory. The text is taken from the 'Lehrbuch,' with here and there modifications of the phraseology, and with connecting new short parts to supply the place of some of the elided portions. The figures are nearly all from the 'Lehrbuch.'

Those who are familiar with the larger text-book will therefore have a very good conception of the character of the new volume and will find again the familiar merits and defects.

The author has been one of the foremost of embryological investigators, confining, however, his original researches to a few fields. On such topics as the history of the genital products he writes with full mastery of the subject, and his fine gift for the understanding of morphological problems, and his rare ability as an expositor, have combined to render all such parts of the volume of the very highest excellence. Unfortunately he seems to have been indifferent to the study of many other aspects of embryological study, and to have been satisfied with a somewhat vague aquaintance with many important parts of the science. This general defect shows very strongly in the absence of original illustrations, and in the fact that a large proportion of the minority of original figures are diagrams. Of these diagrams some are strangely incorrect, as, for instance, those of the development of the middle germ layers and those of veins. These diagrams indicate developmental processes, which are diametrically opposed to the observed facts. Equally unfortunate are his diagrams of the fœtal envelopes in birds and in mammals, since they are in part quite erroneous. As some of the figures are copies after inaccurate originals, there is need for still further revision : thus in Fig. 144, the amnion and chorion are wrongly represented, and the epithelium of the chorion is not only misdrawn but is labeled *decidua reflexa.* There are in the text also deficiencies which would certainly be corrected if the author's study of the embryonic conditions were made to a larger degree at first hand, for example, and notably in the case of the liver, the veins, the thymus, the pharynx and its appendages, the brain and certain other parts.

But though one may regret these and other deficiencies, some of which are very difficult to excuse, it remains true that the book deserves far more praise than fault-finding, and it ought to have a generous and hearty welcome, so that further editions may be called for soon, in which the author will have an opportunity to make the much-needed improvements. It is with regret that the reviewer finds himself obliged to qualify his recommendation of a work which he has found very helpful and stimulating.

C. S. MINOT.

Studies of American Fungi: Mushrooms, Edible, Poisonous, etc. By GEORGE FRANCIS ATKINSON, Professor of Botany in Cornell University, and Botanist of the Cornell University Agricultural Experiment Station. Andrus & Church, Ithaca, N. Y., U. S. A., publishers. 8vo. Pp. i–vi, and 1–275, with 76 plates and over 150 text illustrations. Price, $3.00, postpaid.

In the publication of this book, which has just come from the Genesee Press, Rochester, N. Y., it seems desirable that the author should call attention to some of its features, the importance of which might at first be overlooked. In this connection it may not be out of place to first make some general statements regarding the book, a few of which are adapted from the introduction.

Since the issue of my 'Studies and Illustrations of Mushrooms,' as bulletins 138 and 168 of the Cornell University Agricultural Experiment Station, there have been so many inquiries for them, and for literature dealing with a larger number of species—it seemed desirable to

publish, in book form, a selection from the number of illustrations of these plants which I have accumulated during the past six or seven years. The selection has been made of those species representing the more important genera, and for the purpose of illustrating, as far as possible, all the genera of agarics found in the United States. This has been accomplished except in a few cases of the more unimportant ones. Nearly all of these genera, then, are illustrated by photographs and descriptions of one or several species, and in the more important genera like *Amanita*, *Lepiota*, *Pleurotus*, *Mycena*, *Lactarius*, *Russula*, *Paxillus*, *Agaricus*, *Coprinus*, etc., a larger number of species are very fully illustrated, showing stages of development in many instances, and with a careful comparison of the different kinds.

Among the other orders of the higher fungi many genera and species of the *Polypores*, *Hedgehog Fungi*, *Coral Fungi*, *Trembling Fungi*, *Puff Balls*, *Stinkhorns*, *Morels*, etc., are illustrated and described. Among these such genera as *Boletus*, *Fistulina*, *Polyporus*, *Hydnum*, *Clavaria*, *Tremella*, *Morchella*, etc., come in for a large number of species with beautiful photographs and careful descriptions. In making the descriptions they have been drawn from studies of living specimens, in many cases showing important characters of development. An attempt has also been made to avoid, as far as possible, technical terms; or to use but few such terms, and the descriptions are intelligible to one who is not a technical student of the fungi. There is some progression in the use of the technical terms in the book, fewer of them being employed in the first part of the book; here they are explained, so that the reader becomes gradually familiar with them. The first few chapters are devoted to a description, in plain language, of the form and characters of mushrooms, as well as the course of development. In addition, there is a chapter, at the close, dealing with the more technical characters, and illustrating them.

There are chapters on the collection and preservation of the fleshy fungi, how to photograph them and keep records of the important characters, which often disappear in drying; on the selection of the plants for the table, etc. Mrs. Rorer contributes an excellent chapter on 'Recipes for cooking Mushrooms,' and Mr. J. F. Clark one on the chemistry and toxicology of mushrooms. There are also complete analytical keys to the genera of the agarics found in the United States, and keys to the orders of the higher fungi. The glossary deals only with the few technical characters employed in the book.

The photographs have been made with great care after considerable experience in determining the best means for reproducing individual, specific and generic characters, so important, and so difficult to preserve in these plants, and so impossible, in many cases, to accurately portray by former methods of illustration. Over 200 of the illustrations are half-tone engravings from these photographs. Seventy of these are used as full-page plates and over 150 of the half-tones are text illustrations. Fifteen additional species are illustrated in color. In the legend of the half-tones, text illustrations, as well as plates, the color of the cap, stem and gills is given.

One feature, which the author regards as a very important one, needs explanation, since it might seem unnecessary to some to introduce it in the book. There is at present so much confusion in the determination of the American mushrooms, and so many references to them are made in some publications, which are unsupported by any evidence which would serve as a guarantee that the species has been rightly determined, or that it occurs at all in the locality cited, I have followed the plan in late years of preserving all the material from which the photographs are made, even of the common species.

Furthermore, all material collected and preserved for the herbarium, or for photographic purposes, is entered in a record book, even different collections of the same species, so that this material if divided and distributed will carry the original number. The negatives and photographs carry a corresponding number. In nearly all the photographs in this book, then, it is possible to find the actual specimens from which the photograph has been made if ever any doubt should arise as to the correct determination of the illustra-

tion in question. For this reason the number of the specimens from which the photograph has been made is given in parentheses usually following the description of the species. These specimens and photographs, then, become of nearly, if not quite, equal value to type specimens.

The purpose of the book is to present the important characters which it is necessary to observe, in an intelligible way; to present life-size photographic reproductions accompanied by plain and accurate descriptions, so that by careful observation of the plant, and by comparison with the illustrations and text, even a beginner will be able to add many species to the list of edible ones, where now, perhaps, the collections are confined to the 'pink unders.' The number of people in America who interest themselves in the collection of mushrooms for the table is small compared with those in some European countries. This number, however, is increasing, and if a little more attention were given to the observation of these plants and the discrimination of the more common kinds, many persons could add greatly to the variety of foods and relishes with comparatively no cost. The quest for these plants in the fields and woods would also afford a most delightful and needed recreation to many, and there is no subject in nature more fascinating to engage one's interest and powers of observation.

In addition to the purposes named above, the book has others. There are many important problems for the student in this group of plants. Many of our species and the names of the plants are still in great confusion, owing to the very careless way in which these plants have usually been preserved, and the meagerness of recorded observations on the characters of the fresh plants, or of the different stages of development. The study has also an important relation to agriculture and forestry, for there are numerous species which cause decay of valuable timber, or by causing 'heart rot' entail immense losses through the annual decretion occurring in standing timber. If the book contributes to the general interest in these plants as objects of nature worthy of observation; if it succeeds in aiding those who are seeking for information of the edible kinds; and stimulates some students to undertake the advancement of our knowledge of the group which may form a more scientific basis for their arrangement, it will serve the purposes the author had in mind in its preparation.

GEO. F. ATKINSON.

Engine Tests. By GEORGE S. BARRUS, S.B., New York, D. van Nostrand Co. 1900. 8vo. Illustrated. Pp. 338.

This work is of a kind always welcomed by the scientific practitioner in engineering; it is a collection of experimental data gathered together by a well-known and skilled expert of rare experience and, what is still more rare, one who is accustomed to compel every scientific device and method to his service in his professional work. Mr. Barrus was one of the first in his profession to make use of the laboratory and exact scientific methods of determining the quality of steam supplied by the boiler and received at the engine, and to correct the previously always approximate figures for engine and boiler efficiency by reference to this datum. He had the exceeding good fortune to be engaged in some of the first and most important of the scientific studies of engine and boiler efficiency made at the Massachusetts Institute of Technology. He went out into an extensive and varied and fruitful practice as consulting engineer for New England steam users and carried with him that knowledge of scientific methods and that appreciation of their value which made him a pioneer in the introduction of precise measurements into the practical work of the engineer. His publications represent the outcome of twenty-five years of excellent scientific work.

In 1891 Mr. Barrus published a volume of selected reports upon steam-boiler efficiencies, and its reception was such as to induce him to publish this volume on steam-engine data. The two volumes probably contain a larger body of recent and exact data of this kind than any similar mass of existing technical literature.

The introductory portion includes a carefully written account of the methods employed in securing the data submitted, as of measuring the feed-water, determining leakage, calibration of

the delicate instruments employed, conduct of the work of collecting data, method in detail of working up results from the logs and indicator diagrams, and methods of adjustment of system of test to character of engines and boilers in hand.

A second part presents the details of tests of simple, compound and triple expansion engines, summaries of the work, and a review in which are given his deductions as to magnitude and character of internal thermal wastes, effects of varying engine-speeds, steam-pressures, superheating, condensing, and the relative values of the types of engine described, effects of steam-jacketing and of reheating in multiple-cylinder engines and of variations of proportion. The pressure diagrams taken with the indicator from the steam-chest or the steam-pipe of the engine constitute a rare collection of useful data. Sample indicator-diagrams are given from all the engines and are admirably reproduced by the engraver. The book is printed upon heavy calendared paper and is a good piece of work.

The deductions and conclusions of the author are likely to be very helpful to the practitioner and there still is left for the reader the opportunity to study out many interesting, and some valuable, practical and scientific facts, laws and important conclusions.

R. H. THURSTON.

Experimental Chemistry. By LYMAN C. NEWELL, Ph.D. (Johns Hopkins), Instructor in Chemistry in the State Normal School, Lowell, Mass. Boston, D. C. Heath & Co. 1900. Price, $1.10.

The aim of this book as expressed in the preface is 'to provide a course in chemistry which shall be a judicious combination of the inductive and deductive methods.' The author has selected representative experiments and has left many of the properties, of the substances experimented with, to be determined in the laboratory by the student. A number of simple quantitative experiments and problems are given and several features are added which give considerable choice in the selection of topics for discussion. A number of subjects, suggested by the experiments, are given for discussion in the laboratory and a number of classroom exercises, in the shape of subjects concerning the historical and descriptive side of chemistry, suggest different phases of the science upon which emphasis can be laid. The book is clearly written and the explanations are sharp and to the point, and it will no doubt prove of value in normal schools and colleges. A teachers' supplement accompanies it.

J. E. G.

The Arithmetic of Chemistry. By JOHN WADDELL, B.Sc. (London), Ph.D. (Heidelberg), D.Sc. (Edin.), formerly assistant to the Professor of Chemistry in Edinburgh University. New York, The Macmillan Co. 1899. Pp. 136.

This book is intended to assist students in overcoming the difficulties they encounter in making chemical calculations. After describing the methods of calculating simple and complex weight relations, the author devotes chapters to the volume of gases, calculations involving weight and volume, calculations of analytical analysis and of formulæ. An appendix contains tables which may have to be consulted in making the calculations. In each chapter the principle is clearly explained by a number of examples, and a variety of problems taken from examination papers of different universities are given, which can be solved by the student. One who has worked through this book should have a good grasp of the principles involved.

J. E. G.

Die Chemie im täglichen Leben. Von PROFESSOR LASSAR-COHN. Vierte Verbesserte auflage. Hamburg, Leopold Voss. 1900. 4 Marks.

Few popular works on chemistry have earned recognition in as short a time and in such degree as this. Not a text-book, its popularity is solely due to its acceptance by the general reader. The first edition appeared in December, 1895, an English translation by M. M. Patterson Muir, with title, 'Chemistry in Daily Life,' being published shortly after by the J. P. Lippincott Co. Since then a Russian and an Italian translation have appeared, and also a second English edition, while translations into Servian, Portuguese, Bohemian, Swedish and Polish are announced.

The book is the record of popular lectures delivered at Königsberg. Teachers of chemistry will approve the skill and ease with which subjects seemingly difficult to present are made clear to the average reader. Among the topics treated are lighting, food, explosives, glass, soda, photography, paper, dyes, tanning, metallurgy, alloys. This work in the original or in the excellent English translation, should be in every school library and public library, for there is no other popular book giving the same information, while the information is given in an admirable way.

E. Renouf.

ANTHROPOLOGICAL PUBLICATIONS OF THE AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK, IN 1900.

The Thompson River Indians of British Columbia. By James Teit, Mem. of the Am. Mus. of Nat. History, Vol. II, and of Anthropology, Part IV, Vol. I. The Jesup North Pacific Expedition. New York, April, 1900. Pp. 163–390. Pls. XIV–XX. Figs. 118–315. Map. 4to.

Basketry Designs of the Salish Indians. By Livingston Farrand. Same Series, Part V. April, 1900. Pp. 391–400. Pls. XXI–XXIII. Figs. 316–330. 4to.

Archeology of the Thompson River Region, British Columbia. By Harlan I. Smith. Same Series, Part VI. May, 1900. Pp. 401–454. Pls. XXIV–XXVI. Figs. 331–380. 4to.

Symbolism of the Huichol Indians. By Carl Lumholtz. Same series, Part I, Vol. III. May, 1900. Pp. 1–228. Pls. I–IV. Figs. 291. Map. 4to.

Traditions of the Chilcotin Indians. By Livingston Farrand. Same Series, Part I, Vol. IV. Pp. 1–54.

The Jesup North Pacific Expedition, organized in 1897, has for its aim the history of man, past and present, dwelling on the coasts of the North Pacific Ocean. Beginning at the Amur River in Asia, the exploration will extend northwestward to Bering Sea and thence southeastward along the American coast as far as the Columbia River.

The generous patron, whose liberality made possible both the research and the enjoyment of it by the public through this series of monographs, is Mr. Morris K. Jesup, during the last twenty years President of the American Museum of Natural History, New York City. The execution of the tedious and difficult task is intrusted to the Anthropological Department, of which Professor F. W. Putnam is chief, the responsibility of the exploring and publishing falling on the shoulders of Professor Franz Boas. No pains or expense has been spared in the paper, the printing or the illustrations of the monographs. We do not like the size, 11 x 14 inches, although Berlin, Dresden and Philadelphia have set the bad example.

The Thompson River Indians and the Thompson River region come in for the lion's share of attention. This stream is a branch of the Fraser River, in middle British Columbia, its headwaters almost touching those of the Columbia and Mackenzie. The tribe here studied, better known as the 'Couteau' or 'Knife' Indians, belong to the Salishan family. There are 209 of them, and Dr. Boas finds their number decreasing. Mr. Teit, author of the monograph, is an old resident of the region, conversant with the language, and he has done his work under one of the foremost of ethnologists. His descriptions of dress, food, arts, trade, travel, transportation, warfare, social life, fine art, folk-lore and religion, supplemented by pictures drawn from specimens, and photographs made on the spot, form an ideal contribution to knowledge. From his minute examination it is shown that the Thompson River Indians and their ancestors were an upland people, influenced greatly by tribes farther eastward, little by those on the coast. They are not high in the scale of social organization or religion, and, like other Salishan tribes, have absorbed much and given out little.

Dr. Farrand's paper on basketry patterns is most timely. It not only rounds out Mr. Teit's studies, but it enters a new and inviting field. The basket fever is now raging, in most contagious form. The materials, patterns, stitches, colors and general designs are quite well understood; but no one dreamed until recently that there were mines of folk-lore in the patterns. The reader will find in Mr. Farrand's paper about forty of these from Thompson

River and Quinaielt baskets deciphered. We have lately heard that Fig. 9, Plate XXIII, for which Dr. Farrand was not able to obtain explanation, stands for the forms assumed in the clear fresh water lakes. This design reaches far to the southward. Dr. Hudson has gathered the meanings of about 80 symbols from the Pomos; Dr. Hough, many from the Mokis; and Mr. Roland B. Dixon understands many in middle California.

Complementary to Mr. Teit's studies is that of Mr. Harlan I. Smith, a trained archeologist, at Spence's Bridge, Kamloops, and in Nicola Valley, a former paper (III) being devoted to Lytton, at the junction of the Fraser and the Thompson. There is no evidence on the upper Fraser of great antiquity. One interesting discovery of Mr. Smith's was of rock-slide burial. The bodies of the dead were laid at the foot of a talus, at times covered with a framework as of a miniature tent. Rocks and débris were then slid down over all. In this exploration, the resources of the former population, including copper and nephrite, were brought to light, as well as their arts in stone, bone, shell, wood and textile. Not a shadow of pottery was encountered. The ancient people were hunters, fishers and 'diggers,' skin-dressers, stoneworkers and makers of basketry; they smoked and gambled. In fact, in all important respects they were the ancestors of the 'Couteaux.' They were not coast people, though they borrowed from the last named; but they had chosen affinities with tribes of Oregon and California, both physically and industrially.

Dr. Farrand's second paper (No. I of Vol. III) is devoted to the traditions of the Chilcotin Indians (Athapascan family), living on the Chilcotin River, a branch of the Fraser, 52° north. This tribe of Athapascans, wedged in between Wakashan and Salishan tribes, offers an extraordinary opportunity of testing the modern fad in ethnology, that of 'independent development.' We are not surprised to find a practiced field hand like the author saying "there is not a very rich, independent mythology, but surprising receptivity to foreign influences. * * * Comparatively few of the traditions exhibit unmixed Athapascan characteristics." Nearly every element of the culture-hero story is said to be found in one or more of the neighboring tribes, while in no one is there a complete correspondence in the whole myth. Mr. Farrand had a goodly mass of material for comparison in the voluminous writings of Father Morice, Abbe Petitot, Boas, Teit and Rand.

Mr. Lumholtz's generous monograph, of 228 pages, does not belong to the Jesup North Pacific Series, but treats of a little known tribe of Nahuatlan Indians, called Huichols, numbering 4,000 souls and living in the Sierras, on the Chapalangana River, a branch of the Rio Grande de Santiago, in the northwestern corner of the State of Jalisco, Mexico. These Indians, though conquered by the Spaniards in the 16th century, keep their ancient customs, beliefs, and ceremonies. Mr. Lumholtz devotes a few pages to the Huichols and their arts and then sticks bravely to his text, the patient detail of their symbolism. The four principal male gods are the god of fire, the chief deer god, the sun god, and the god of wind or air (Elder Brother, or Grandfather). The chief female deities are Grandmother Growth, Mother East-Water, Mother West Water, Mother South-Water, and Mother North-Water. Sacrifices are made to these and many others as prescribed.

The interesting cult of hi'kuli, the mescal button (*Anhalonium Lewinii*) is described and illustrated, and the names of cult animals identified. With great care the author sets forth and pictures the ceremonial dress and objects and symbols. Mr. Lumholtz's personal equation has a decided leaning against acculturation. This prejudice reaches its climax on page 206, where he figures a musical bow of African origin and says: "These facts settle beyond doubt the questions recently raised whether or not there is a musical bow indigenous to America. To deny its existence among the Coras and their northern neighbors would be equivalent to denying the originality of the Huichol drum." That is a little too strong. But the notched bones figured on the same page are infinitely more interesting, having a far more puzzling distribution. The concluding chapters, in which symbols and prayers are briefed and indexed, will enable the student to utilize the author's material economically.

For the series here described, the American Museum and Mr. Jesup, the Maecenas of American ethnology, deserve hearty praise. It is now in order for others of our great museums to wake up and let us hear from them.

O. T. MASON.

BOOKS RECEIVED.

Geometrical Optics. R. A. HERMAN. Cambridge University Press. New York, The Macmillan Co. Pp. x + 344. $3.

Photographic Optics. OTTO LUMMER. Translated and augmented by SYLVANUS P. THOMPSON. London and New York, The Macmillan Co. 1900. Pp. xi + 135. $1.90.

The Elements of Hydrostatics. S. L. LONEY. Cambridge University Press. New York, The Macmillan Co. 1900. Pp. x + 248 + xii. $1.00.

Botany. L. H. BAILEY. New York and London, The Macmillan Co. 1900. Pp. xiv + 355. $1.10.

A Text-book of Important Minerals and Rocks. S. E. TILLMAN. New York, John Wiley & Sons; London, Chapman & Hall (Ltd). 1900. Pp. 186. $2.00.

SCIENTIFIC JOURNALS AND ARTICLES.

THE *Bulletin of the American Geographical Society* for October 31, 1900, contains an excellent picture of the late president of the Society, the Hon. Charles P. Daly, which forms the frontispiece of this number. Judge Daly was the honored president of this, the oldest Geographical Society in America, and the portrait painted by Harper Pennington forms a fitting memorial of the thirty-five years of active service to the Society. The number contains a larger series than usual of what might be called new articles. First among these is an article upon the 'Ethnology of Madagascar,' by the Hon. W. H. Hunt, of Tamatave, dealing largely with the tribal names and the early immigrations, showing that there must have been a series of migrations from an Asiatic source. The second section of the paper discusses the early maps of the island, and then takes up the geography and cartography of Madagasgcar as developed between 1897 and 1899. This new work is due largely to the initiative of General Gallieni. This is followed by an article descriptive of the 'Heaths and Hollows of Holland,' by Dr. W. E. Griffiths, a bright and entertaining tale of this 'water-logged' country and its people. 'Korea's Geographical Significance' is discussed by H. B. Hulbert, of Seoul, in a scholarly paper showing the relations brought about by this stepping stone from Asia to Japan, giving the results produced as a link between two widely separated branches of the Turanian stock; and then again when serving as a barrier between active Japan and ambitious Russia. Mr. Henry Gannett, of Washington, gives a careful *résumé* of the recent census of Porto Rico. This new addition to our domain has a population of 963,243, thus showing a very dense population of its 3,600 square miles. An outline sketch of the geography of British Honduras is given by Hon. W. L. Avery, of Belize. This is followed by an account of a trip through the silk and tea districts of Kiangnan and Chepiang, by E. S. Fischer. The portion of the *Bulletin* devoted to notes in this number is particularly full, and covers the departments of physiography, map notices, climatology, geographical education and the general geographical record. Cosmos Mindeleff gives a full account of the use and manufacture of geographical relief maps, and M. Henri Froideveaux gives a sketch of geography at the Paris Exposition. At the end of the number there is a picture of the new home of the Society, Manhattan Square on 81st street, giving a view of the front of the building and plans of the grounds and library floors. The enterprise of the Council in constructing this building as a repository for its fine library and a commodious place for the intercourse of the Fellows of the Society, is deserving of the highest praise.

The Plant World for October opens with 'Notes for the Beginner in the Study of Mosses,' by F. H. Knowlton, the first of a series on the lower plants. A. S. Hitchcock describes 'Collecting Sets of Plants for Exchange'; E. J. Hill has 'An Observation on the Water-Shield (*Brasenia peltata*), dealing with the dissemination of its seed; Charles Newton Gould describes the 'Radiate Structure of the Wild Gourd' (*Curcubita fœtidissima*), and Joseph Crawford has some 'Notes on Ophioglossum.' In the supplement devoted to 'The Families of Flowering Plants,' Charles Louis Pollard deals

with the orders Verticellatæ, Piperales, Salicales and Juglandes and their allies.

THE *Journal of the Boston Society of Medical Sciences* for October begins with a discussion of 'The Antitoxin Unit in Diphtheria,' by Theobald Smith, detailing various experiments made, and concluding that at present we cannot do better than to utilize the standard provided by Ehrlich which is described in the paper. John Lovett Morse has an abstract of a paper on 'The Serum Reaction in Fœtal and Infantile Typhoid,' and Albert P. Matthews describes 'Artificially produced Mitotic Division in Unfertilized Arbacia Eggs,' caused by lack of oxygen, heat and the action of alcohol, chloroform and ether. Martin H. Fischer has a preliminary communication on 'The Toxic Effects of Formaldehyde and Formalin,' and William Sydney Thayer has some 'Observations on the Blood in Typhoid Fever,' being an analysis of the examinations of the blood in typhoid fever made in the Johns Hopkins Hospital during eleven years.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 327th regular meeting was held on Saturday evening, November 3d.

Under the head of 'Notes' F. A. Lucas described a specimen of the buffalo-fish, recently received by the U. S. National Museum, which had no mouth, the bones of the jaws having failed to develop. The fish must have fed by means of the gill openings and had attained a weight of more than a pound when caught. W. H. Dall called attention to the discovery, by Mr. T. Wayland Vaughan, of a fossil coral reef in Decatur Co., Georgia. This reef, which was of Oligocene age, resembled the fossil reefs in the Island of Antigua and was noteworthy from the large number of species represented, the reefs of the Tertiary beds usually being poor in the number of species of corals.

Under the title, 'Insects affecting Cotton,' L. O. Howard, following the 'symposium on cotton,' which occupied the last meeting of the Society, made some observations on the principal insect enemies of the plant. He presented accounts of *Aletia xylina*, *Heliothis armiger*, *Dysdercus suturellus*, and *Anthonomus grandis*, noting various outbreaks of these pests and describing their habits, transformations and the remedies employed.

Henry James spoke of 'Recent Progress in Forestry,' saying that the great obstacles to improvement in the management of forests in America were first, from the point of view of a forester, the new trees and conditions which have made the application of European methods in this country impossible, and, second, the almost total lack of examples of successful forest management.

During the last two years, however, this condition of things has greatly improved. The offer of the Division of Forestry, through the Department of Agriculture, to examine forest tracts and prepare 'working plans' for their management free of charge, has been taken advantage of on every side; and it has thus been made possible for the division to give object lessons in forest management in many parts of the country, and to gain knowledge and experience in a most practical way. In New York, for instance, a working plan is now being prepared for a part of the State Forest Preserve in the Adirondacks. On the Pacific coast the day of conservative lumbering is being brought nearer by investigations of the habits of growth and reproduction of some important lumber trees. These are making it clear among other things that the Red Fir and the Redwood reproduce more easily and will grow to a merchantable size much sooner than has hitherto been supposed. Similar observations are being made in other parts of the country, and interest in forestry is everywhere spreading rapidly. This is partly because people are realizing the importance of ample forest resources and a steady supply of water, partly because foresters can more often get down to terms which appeal to practical landowners. It means that soon many States will be following the example of Indiana, Pennsylvania and one or two others in taking hold in earnest of such important problems as those relating to protection from fire and reform in forest taxation. Forestry is appearing daily as something practical and desirable to more and more owners of forest land and voters generally who shape legislation.

M. W. Lyon presented some 'Notes on the Zoology of Venezuela,' stating that he spent the months of July and August in that country in company with Lieut. Wirt Robinson, collecting zoological material, especially the mammals. On the way down one day was spent at the interesting island of Curaçao, a few miles from the South American mainland. The mammal fauna of this dry and rather barren island consisted of several species of bats and a rabbit. Of the former eight are known to be peculiar, but related to the mainland forms, although one genus, *Leptonycteris*, has never been taken nearer than Central America. We are indebted to Mr. Guthrie, in the United States Weather Bureau Service, for our knowledge of Curaçaoan bats.

On the continent, collecting was confined to the vicinity of La Guaira, at the base of the extensive range of mountains that border the northern coast of South America. The first few hundred feet of hills about La Guaira are remarkably dry and covered with scrubby trees and bushes, agaves and post-cactuses, but at higher elevations where the moisture is greater is an abundant growth of tropical trees, shrubs and vines. The fauna of the dry region is quite different from that higher up, and consists principally of certain species of birds and lizards. Mammals, as well as more or less characteristic birds and reptiles, are apparently confined to the better wooded regions, or in the narrow valleys that the mountain brooks make on their way to the sea. There are no rivers in the neighborhood. Diligent trapping does not result in the numerous small mammals, as in temperate regions or certain places in the tropics. Bats are abundant in species and individuals, and may be found roosting in dense trees, in houses, or in the few small so-called caves in the region. Among the more interesting ones are disc-bats, of the genus *Thyroptera*, with a sucking disc near each wrist and ankle joint, by means of which it can adhere to and move over smooth surfaces as glass, in the manner of a fly, and the vampire, a moderately sized bat with a special dentition and alimentary canal for drawing blood from animals and digesting it. The native or spiny rat, *Loncheres*, while belonging to an entirely different section of the rodents, shows a striking external resemblance to the house rats found about the towns and brought in with the advent of the Europeans. Several other rodents occur and four species of opossums are found, including one of shrew-like form and habits, of the genus *Peramys*.

F. A. Lucas spoke of 'The Deposit of Mastodon Bones at Kimmswick, Missouri,' saying that this extraordinary aggregation of bones and tusks represented hundreds of individuals of all ages and sizes. But a small portion of the deposit had as yet been worked, but from this had been obtained teeth and bones representing between two hundred and three hundred animals. The full paper will appear in SCIENCE.

F. A. LUCAS.

DISCUSSION AND CORRESPONDENCE.

THE RELATION OF THE NORTH AMERICAN FLORA TO THAT OF SOUTH AMERICA.

TO THE EDITOR OF SCIENCE: In the interesting article by Professor Bray on the relations of the North American Flora to that of South America, in your issue of November 9th (pp. 10–11), there are some geological assumptions which are so at variance with the information now attainable that it seems well to call attention to them. It is true that most of them are of ancient date and found more or less accepted in the literature, and that their erroneous character does not materially affect Professor Bray's botanical conclusions; moreover, the present state of our knowledge has been set forth in the annotations to a table of our Tertiary horizons which appeared in the 18th Annual Report, U. S. Geological Survey, Part II, pp. 323–348, 1898. Nevertheless, they are so confidently stated by Professor Bray that it is quite likely that they may be accepted by botanical students and others not especially conversant with geology, and prove less innocuous than in the present case.

In the first place, Professor Bray has been misled by the long continued practice of authors in referring the basal Middle Oligocene of Central America and the West Indies to the Miocene. It was during this period that Central America formed a series of islands and the lagoon islets of south Florida first appeared above the sea. During the Miocene, however,

there is no evidence that any part of Central America which is now above it was below the sea. No true marine Miocene beds have been recognized in any part of the Caribbean, Antillean or Middle American region. Florida alone shows Miocene, not only about the southern borders of the group of islets which formed the nucleus of the present peninsula, but also across the neck of the peninsula; which in Miocene times was a wide, shallow strait between the islands and the mainland of Georgia and has been named the Suwanee Strait.

Secondly, this Oligocene (formerly called Miocene) time was warm, but the true Miocene was a relatively cold period and is marked by a climatic change so sharp that the marine Oligocene fauna was almost wholly driven out of the Gulf and Floridian region, which was invaded by a cool-water fauna from the north, corresponding to the present fauna of New Jersey. The Arctic and Alaskan leaf beds, called Miocene by Heer, are now generally referred to some part of the Eocene column, and in Alaska are overlaid by the cooler marine fauna of the true Miocene. In the Pliocene, on the other hand, at least in Florida and the coast northeast of it as far as Chesapeake Bay and probably to Martha's Vineyard, there was a change to a warmer marine condition, which carried several semi-tropical forms of mollusks as far north as Massachusetts, and was accompanied by a slight subsidence in the Gulf region and on the Central American coast. In Tehuantepec the coastal plain was submerged to a depth of at least 600 feet, though whether the connection between the two oceans was renewed is not yet known. The ice age was, in the Gulf region, ushered in by a slight elevation of the land, and a return to slightly cooler conditions of the sea, but not to as great a degree as during the Miocene, the northern current, if any, being probably diverted off shore or cut off entirely.

Lastly, there is no reason, paleontologically speaking, for believing that the Antilles or the Florida peninsula has ever been connected with South America since the Mesozoic, if at all. On the contrary, there are strong reasons for believing that the insular condition has been maintained in nearly all the islands (excluding Trinidad and those adjacent to it) from an early period in the Eocene to the present day. It is probable that the distribution of the flora can be fully accounted for without resorting to the hypothesis of an unbroken land connection.

WM. H. DALL.

SMITHSONIAN INSTITUTION, November 12, 1900.

PALEONTOLOGICAL NOTES.

THESPESIUS VERSUS CLAOSAURUS.

IN 1856 Dr. Leidy described in the Proceedings of the Academy of Natural Sciences of Philadelphia two vertebræ and a proximal phalanx, for which he proposed the name of *Thespesius occidentalis*, stating that they probably came from some Dinosaur, although they might prove to be mammalian. Comparison of these bones with the similar parts of *Claosaurus annectens* of Marsh shows them to be identical and that consequently this Dinosaur must be known by Leidy's name.

A NEW LOCALITY FOR THESPESIUS.

THE U. S. National Museum has recently received from Mr. Harvey C. Medford, of Tupelo, Miss., the greater portion of the right femur of a large Dinosaur obtained near that place. This femur agrees exactly with the corresponding femur of a large and very complete specimen of *Thespesius occidentalis* collected by Mr. J. B. Hatcher in Wyoming, and certainly belongs to the same genus if not the identical species. This is the most southern locality for *Thespesius*, if not the first record of Dinosaur remains in the State of Mississippi.

THE DERMAL COVERING OF THESPESIUS.

THE impressions of the dermal covering of *Thespesius* (*Claosaurus*), noted by Mr. Hatcher in SCIENCE for November 9th, are of great interest, although they are not the first that have been discovered. Some years ago the U. S. National Museum obtained from Mr. Robert Butler a fine skull of *Thespesius*, together with other bones, and several pieces of sandstone bearing the impressions of small horny scutes, similar to those described by Mr. Hatcher.

THE DENTITION OF BASILOSAURUS CETOIDES.

IN the *American Naturalist* for August, 1894, attention was drawn to the fact that at least the lower molariform series of Zeuglodon contains

six teeth, or one more than it is usually credited with. The specimen in the U. S. National Museum shows also that the first upper premolar is not a two-rooted tooth, but a single-rooted canimiform tooth having a very small accessory cusp on the posterior face. The first lower premolar is a large tooth with two roots. A jaw of *Dorudon* collected by Mr. Charles Schuchert seems to show that the Zeuglodonts were diphyodont, for it contains several teeth much smaller than those found in other specimens and these teeth had apparently not been fully extruded.

THE HYOID OF BASILOSAURUS.

ACCOMPANYING the skull obtained by Mr. Schuchert is a series of bones considered as constituting the hyoid. The complete hyoid is much like that of a toothed whale but with very much longer arches. The basihyal is flat beneath, slightly hollowed above, the ceratohyals are immensely long, 35 cm., and quite slender; the thyrohyals are stout at the point of articulation with the basihyal, taper slightly and are 25 cm. in length.

THE CRANIAL CAVITY OF BASILOSAURUS.

A CAST made in the cranial cavity of an imperfect specimen of *Basilosaurus* shows the brain to have been comparatively smooth and of a most extraordinary shape, being very much wider than long, owing to its excessive prolongation in the auditory region. The separation between cerebrum and cerebellum was rather slight, the tentorium being a mere low ridge.

F. A. LUCAS.

FORESTRY IN THE PHILIPPINES.

STRANGELY enough, there comes from our far distant possessions in the Pacific Ocean—which we are apt to think backward in all directions of economic development—a call for technically educated assistants in a branch of economics, which in our own country is only just beginning to be appreciated.

The Forestry Bureau at Manila, which is in charge of Capt. Ahern, U. S. A.—a most energetic officer who took great interest in advocating rational forestry methods for our public domain—is an inheritance from the Spanish government. It was established as long as 35 years ago, and employed 66 foresters, as many rangers and 40 other subordinates supervising the exploitation of the government forest property, which, according to estimate, comprises between 20,000,000 and 40,000,000 acres.

Capt. Ahern writes that he found 'the regulations in force in August, 1898, excellent, practicable and in line with the most advanced forestry legislation of Europe,' so that they could in the main be re-enacted, but, to be sure, the laws and regulations were not fully enforced and scientific forestry not practiced, and "it did not take long to develop the fact that the foresters knew very little of practical forestry, beginning their work after the trees had left the forest, not before, *i. e.*, devoting all their attention to collecting revenues."

At present even a revenue of about $8,000 per month is derived from licensees, who are mainly engaged in collecting guttapercha, rubber, gum, varnish, dye woods (some 17 kinds) and firewood, besides some of the very valuable hard woods.

Over 400 species of trees are known and a more careful survey will bring the number nearer 500. Of these at least 50 are valuable, the Yang-ylang tree being considered among the most important. This furnishes an oil which forms the base of many renowned perfumes. On the island of Romblon, a mass of cocoa palms, the result of planting under a former governor, covers the slopes from sea to mountain top, furnishing a yearly revenue of from one to two dollars per tree.

There are altogether, according to Blanco's magnificent work on the flora of the Philippines, 28 genera of palms with 87 species, the most important of which is *Coryphæa umbellaria.*

There are 22 species of Cupuliferæ, with two oaks (*Quercus costata* and *conocarpa*), and five genera of conifers with nine species; one only true pine, *Pinus insularis*, occurring in dense forests in the island of Luzon, above 4,000 feet altitude.

The families of Rubiaceæ, Rutaceæ, Ebenaceæ and Leguminosæ furnish quite a large number of arborescent species. Coffee trees grow wild on the slopes, replacing the original growth, when invaded by the wood chopper.

A very large number of the tree species have officinal value.

Means of communication are hardly yet developed, hence only the outer fringe of the forest has been cut away and lumbering is comparatively expensive, especially as no one gregarious species may be exploited, but, as is usual in tropic forests, a profusion of species occupies the ground; hence systematic exploitation which uses all that is valuable at one and the same time can alone pay for development of means of transportation. Capt. Ahern calls upon the N. Y. S. College of Forestry for six technically educated foresters to assist him in organizing his bureau on better lines than under Spanish rule and also proposes to send some Filipino college graduates to take forestry courses at Cornell. B. E. F.

PROFESSOR ROSS AND LELAND STANFORD, JR. UNIVERSITY.

THE enforced resignation of Professor E. A. Ross from the chair of sociology at Leland Stanford, Jr. University is unfortunate, whatever the explanation may be. It is well known that Mrs. Stanford occupies a peculiarly responsible position in her relations to the university. She has, we believe, exercised her authority in the construction of buildings, etc., but never, heretofore, has interfered with the work of the professors. Professor Ross has made public a statement from which we quote the following paragraphs:

"At Stanford University the professors are appointed from year to year, and receive their reappointment early in May. I did not get mine then, but thought nothing of it until, on May 18th, Dr. Jordan told me that, quite unexpectedly to him, Mrs. Stanford had shown herself greatly displeased with me, and had refused to reappoint me. He had heard from her just after my address on coolie immigration. He had no criticism for me, and was profoundly distressed at the idea of dismissing a scientist for utterances within the scientist's own field. He made earnest representations to Mrs. Stanford, and on June 2d I received my belated reappointment for 1900–01. The outlook was such, however, that on June 5th I offered the following resignation:

"Dear Dr. Jordan—I was sorry to learn from you a fortnight ago that Mrs. Stanford does not approve of me as an economist and does not want me to remain here. It was a pleasure, however, to learn at the same time of the unqualified terms in which you had expressed to her your high opinion of my work and your complete confidence in me as a teacher, a scientist and a man.

"While I appreciate the steadfast support you have given me, I am unwilling to become a cause of worry to Mrs. Stanford or of embarrassment to you. I therefore beg leave to offer my resignation as professor of sociology, the same to take effect at the close of the academic year 1900–01.'

"When I handed in the above Dr. Jordan read me a letter which he had just received from Mrs. Stanford, and which had, of course, been written without knowledge of my resignation. In this letter she insisted that my connection with the university end, and directed that I be given my time from January 1st to the end of the academic year.

"My resignation was not acted upon at once, and efforts were made by President Jordan and the president of the board of trustees to induce Mrs. Stanford to alter her decision. These proved unavailing and on Monday, November 12th, Dr. Jordan accepted my resignation in the following terms:

"I have waited till now in the hope that circumstances might arise which would lead you to a reconsideration.

"As this has not been the case, I, therefore, with great reluctance, accept your resignation, to take effect at your own convenience.

"In doing so I wish to express once more the high esteem in which your work as a student and a teacher as well as your character as a man, is held by all your colleagues.'"

President Jordan is reported to have said: "In regard to the resignation of Dr. Ross, it is right that I should make a further statement. There is not the slightest evidence that he is a 'martyr to freedom of speech.' Nor is there any reason to believe that his withdrawal has been due to any pressure of capital or any sinister influence. I know that Mrs. Stanford's decision was reached only after long and earnest consideration, and that its motive was the welfare of the university, and that alone."

THE TELEPHONOGRAPH.*

THE telephonograph is a combination of the phonograph with the telephone, and is intended to take and record telephone messages by automatic means, and, to a limited extent, give an answer in the same way. It is the invention of Mr. J. E. O. Kumberg, and an example of the instrument is to be seen at the office of Messrs. H. F. Joel and Co., 31 Wilson street, Finsbury. The combination is simple in general principle, but some ingenious mechanism has been introduced to make the working effective. The message is spoken by the person sending it into the telephone in the usual way, and the vibrations set up by the voice are caused to act upon a recording stylus by the impact of the sound-waves. In this way the wax cylinder in the office of the person spoken to is indented and a phonogram is produced. This, of course, can be read off at leisure in the usual way. The vibrations are transmitted either directly or indirectly, in the latter case an electrical current effecting the object. A highly-sensitive transmitter of any well-known form is used. If it is desired, the instrument may be so arranged that two wax cylinders, or phonograms, may be inscribed, the one being in the office of the sender, to be retained as a record, and the other, an exact duplicate of the first, being produced in the office of the receiver. To effect this end, the transmitter instrument has two channels or tubes for the sound-waves produced by speaking into the mouthpiece. One of these channels leads to the speaking or recording diaphragm of the instrument at the transmitting station, which engraves them upon the phonogram blank. At the same time identical sound waves are electrically conveyed to the receiving instrument at the distant station of the person spoken to, and are there imprinted on another phonogram blank. It is possible to throw the phonograph action out of play and use the telephone in the ordinary way.

Neither the telephone nor the phonograph is perfect in its action, and unpracticed persons are apt at times to experience some difficulty in translating the sounds either one or the other produces into articulate speech ; and when the deficiencies of the two are combined difficulty is still more likely to arise, although proficiency is retained to a remarkable degree by practice. In order to overcome this defect a special design of recording diaphragm cell has been devised by the inventor. It consists of a double cell micro-diaphragm having two compartments, one of which is fitted with a multiple, or other suitable microphone diaphragm disc, and the other with a sensitive disc of glass. This receives the undulations produced by the sound-waves and communicates them to the recording stylus. Below the glass diaphragm is a guard, which serves to confine the sound, and also as a shield against the scraping noise which the stylus makes by cutting into the wax cylinder. One of the most important features of the invention is a floating weight controlled by a spring which is attached by means of a pivoted lever and a fine wire to the two discs, already mentioned, of the double cell micro-diaphragm. The pivoted lever carries the recording and reproducing tools by which the sound vibrations are respectively engraved upon or reproduced from the wax cylinder. The action of the weight is to give additional power, or perhaps, rather, additional certainty and steadiness to the reproducing tools. Such weights have before been used to supply what may be described as a fly-wheel effect, thus enabling the cutting tool to overcome any irregularities in the composition of the wax. The weight, however, is apt to rebound through its own momentum, and thus defeat the end for which it is provided. To overcome this defect a spiral spring is fitted in the machine under notice, with the result that the jumping or vibratory motion is damped. It is claimed that by this device a deeper cut is made in the wax cylinder than has been before obtained, and the reproduction of the sound waves is thereby made more perfect.

We lately had an opportunity of testing this invention to the extent of transmitting a message from one room to another adjoining, although the length of wire represented a considerable distance. As reproduced by means of the phonogram, on which the message was recorded, the words were distinctly audible, the

* From the London *Times*.

result being equal to that of an ordinary phonograph. Mr. Higgins, chief engineer to the Exchange Telegraph Company, has tested the apparatus over a line five miles in length. He reports that under favorable circumstances 'articulation is good, the impressions on the cylinder being as deep as the impressions made when speaking into an ordinary phonograph.' Large battery power was needed and a reinforcing current is required at the receiving and registering line.

In regard to the practical utility of the apparatus those who had experience with the telephone and the phonograph will be able to judge from the description here given. It would be most applicable in small offices where a limited staff is employed. Thus if the office is left without an attendant and a call is made the phonograph can be so set as to reply, "Mr. —— is out. The instrument is fitted with a telephonograph which will automatically take down any message you may send and Mr. —— will read it on his return." The arrangement of the mechanism is such that any number of messages up to an aggregate of 15,000 words may be taken in this way.

SCIENTIFIC NOTES AND NEWS.

SIR WILLIAM HUGGINS, the eminent astronomer, will succeed Lord Lister as the president of the Royal Society. The other officers of the Society will remain as at present with the exception of certain members of the council. They will be as follows: Treasurer, Mr. Alfred Bray Kempe; secretaries, Sir Michael Foster, D.C.L., LL.D., Professor Arthur William Rücker, D.Sc.; foreign secretary, Dr. Thomas Edward Thorpe, C.B.; other members of the council, Professor Henry Edward Armstrong, V.P.C.S., Mr. Charles Vernon Boys, Mr. Horace T. Brown, F.C.S., Mr. William Henry Mahoney Christie, C.B., Professor Edwin Bailey Elliott, Dr. Hans Friedrich Gadow, Professor William Mitchinson Hicks, Lord Lister, F.R.C.S., Professor William Carmichael McIntosh, F.L.S., Dr. Ludwig Mond, Professor Arnold William Reinold, Professor J. Emerson Reynolds, D.Sc., Dr. Robert Henry Scott, Professor Charles Scott Sherrington, M.D., Mr. J. J. H. Teall, Sir John Wolfe-Barry.

THESE officers will be elected at the anniversary meeting of the Society on November 30th, when medals will be presented as follows: The Copley Medal to M. Berthelot, For. Mem. R.S., for his services to chemical science; the Rumford Medal to M. Becquerel, for his discoveries in radiation proceeding from uranium; a Royal medal to Major MacMahon, for his contributions to mathematical science; a Royal medal to Professor Alfred Newton, for his contributions to ornithology; the Davy Medal to Professor Guglielmo Koerner, for his investigations on the aromatic compounds; and the Darwin Medal to Professor Ernst Haeckel, for his work in zoology.

LORD AVEBURY has given the first Huxley Memorial Lecture which the Anthropological Institute of London has established to commemorate Huxley's anthropological work.

F. H. SNOW, Chancellor of the University of Kansas and professor of organic evolution and entomology, has been given a year's leave of absence by the Board of Regents, on account of ill health.

DR. L. O. HOWARD, chief of the Division of Entomology, U. S. Department of Agriculture, has been elected an honorary member of the 'Allgemeinen Entomologischen Gesellschaft.' The other honorary members are: Fr. Brauer, Vienna; Charles Janet, Paris; Sir John Lubbock, London; A. S. Packard, Providence, R. I.; J. A. Portchinsky, St. Petersburg; M. Standfuss, Zürich; E. Wasman, Luxemburg; Aug. Weismann, Freiburg.

DR. RAMON Y CAJAL, the eminent histologist, has been awarded a pension by the Spanish Government, and additional funds have also been provided for the enlargement and maintenance of his laboratory.

YALE UNIVERSITY has conferred the honorary degree of M. A. on Professor H. S. Graves, director of the Yale Forest School.

PROFESSOR BEMIS, director of the New York State School of Ceramics at Alfred University, has been awarded a silver medal at the Paris Exposition for a collection of the economic clays of the United States.

Professor G. Frederick Wright, of Oberlin College, and Mr. F. B. Wright arrived at St. Petersburg on the 14th instant. It will be remembered that they were in the midst of the troubles in northern China.

Dr. N. L. Britton, director-in-chief of the New York Botanical Gardens, has returned from Europe, where he has secured a number of important collections and made arrangements for exchanges.

Llewellyn Le Count, assistant in engineering at Columbia University, died on November 15th at the age of twenty-two years. He was graduated this year from the school of applied science of the university.

The *Auk* records the death of Mr. Charles C. Marble until recently editor of *Birds*, a magazine of popular ornithology.

Applied science is deeply indebted to Mr. Henry Villard for his interest and faith in engineering works, especially the application of electricity before their commercial importance was commonly understood. Mr. Villard was also interested in pure science. Thus the Baudelier Expedition from the American Museum of Natural History to Peru and Bolivia was equipped by him in 1892, and he maintained it until 1894. The results of this expedition to the region of highest pre-Columbian culture in South America form the nucleus of the archeological collection that is now open to the public in the west gallery of the American Museum of Natural History. Mr. Villard also furthered investigations among the native peoples of the Columbia River Valley.

Tufts College will open a small laboratory for marine biology at South Harpswell, Maine, next summer. The fauna there is very rich, and the locality is a delightful one in which to spend the summer. There will be opportunities for a few investigators. All inquiries should be addressed to Professor J. S. Kingsley, Tufts College, Mass.

The meeting of Naturalists of the Central and Western States at Chicago, last year, was so successful that a second meeting will be held at the Hull Biological Laboratories, University of Chicago, on Thursday and Friday, December 27 and 28, 1900, when it is expected that a permanent organization will be effected. The provisional program is as follows: *Thursday*, 10 A. M.—General meeting in Room 24, Zoological Building (furnished with a projecting lantern), for organization and reading of the more general papers. 1 to 2 P. M.—Luncheon at the Quadrangle Club. 3 P. M.—Discussion: State Natural History Surveys; methods, results, cooperation. 6:30 P. M.—Dinner at the Quadrangle Club. *Friday*, 9 A. M.—General meetings for reading of papers. At this time at least two sections, one in Zoology and one in Botany, will be formed, at which the more special papers will be read. The committee on the meeting is E. A. Birge, *Chairman;* C. R. Barnes, T. G. Lee, C. C. Nutting and C. B. Davenport, *Secretary*.

The New York section of the Society of Chemical Industry holds its next meeting on November 23d at the Chemists' Club, 636 W. 55th Street, instead of at the College of Pharmacy as hitherto. The usual informal dinner before the meeting will be held at the Hotel Grenoble, 7th Avenue and 56th Street.

The American Forestry Association will hold a meeting in Washington, on the morning of Wednesday, December 12th. The meeting will be primarily a business meeting. The Board of Directors will make its annual report and officers will be elected for the ensuing year. Members who are in the neighborhood of Washington are urged to be present.

The National Irrigation Congress is meeting in Chicago this week. In addition to special papers on the scientific aspects of irrigation and forestry, addresses have been arranged by Secretary Wilson, of the Department of Agriculture, General Miles and other prominent men.

It is announced from St. Petersburg that Baron Toll's polar expedition, under the auspices of the Imperial Academy of Sciences, is wintering in the Kara Sea, on the northeastern coast of Siberia. It will send an expedition to the Taimyr Peninsula next spring to establish an observation station.

It will be remembered that Benjamin Franklin bequeathed to the city of Boston $5,000,

the interest of which should accumulate for 100 years and then be used for public purposes. The period ended some six or seven years ago and there has been much difference of opinion as to the disposition of the fund which now amounts to $366,880. It appears, however, that a committee of the City Council and the managers of the fund have agreed to recommend that the money be used for the erection of a building to be known as the Franklin Institute, which shall be used for educational purposes, with special reference to artisans.

A NUMBER of American men of science were awarded gold and silver medals at the Paris Exposition. A circular has been sent them, in lieu of the medals, stating that these can be purchased—the gold medal for 600 fr. The value of the gold in the medal is not stated, but it probably allows a generous profit to the promoters of the Exposition. Electrotype blocks of the medals are also offered for sale at a cost that will allow somebody a profit of about 1,000 per cent.

ATTEMPTS have been made to sell a certain book by a person who styles himself 'President of the Natural Science Association of America,' and the name is now being used to promote the sale of mining stocks. There is probably no legal means of preventing the use of an honorable name for such purposes, but there should be some agency such as a committee of the National Academy of Sciences or of the American Association for the Advancement of Science that would prevent people from being deceived by the misuse of a name such as the 'Natural Science Association of America.'

PROFESSOR SMEDLEY, supervisor of the Chicago Board of Education's Department of Child Study has drawn, says the *Medical News*, the following conclusions from the examinations of the eyes of the school children : (1) Dull pupils have a greater number of eye defects than brighter pupils. (2) Defective eyesight causes dulness in the child. (3) The primary rooms in the public schools have the poorest light. (4) Boys have better sight than girls. (5) School life is responsible for many eye defects. (6) The first three years of school life increases eye defects one-third. (7) Of pupils whose sight is but one-tenth the keenness of normal, the number grows steadily larger from the beginning to the end of school life. (8) While in ordinary schools 32 per cent. had only two-thirds of ordinary keenness of sight, in one school 48 per cent. had that degree of eye defects. (9) Such defects undoubtedly were the cause of the presence of many of the pupils in that school. (10) Something must be done at once, at almost any cost, to save school children's eyes.

PROFESSOR GRASSI has just published, says the *Lancet*, another note in the *Rendiconti della R. Accademia dei Lincei*, describing some observations made by him in September of last year and during the past summer at Grosseto with the object of controlling the results obtained last year in July and August by Professor Koch's expedition. The latter, it may be remembered, found very few *anopheles*, but a very great number of *culices* in this city, although malaria was very prevalent, and from this fact he considered it likely that *culex pipiens* is also an agent in the propagation of malaria. Professor Grassi, on the contrary, has found *anopheles* very abundant in the same houses where Koch had noted malaria the previous year, and he concluded from this that Professor Koch's party were inexpert at the work of looking for mosquitoes and that their search was not made in the proper places, which are the entrances of houses and outhouses, and not in the bedrooms. He found that the favorite time for the *anopheles* to feed at Grosseto was the thirty or forty minutes immediately after sunset, and to a much less extent, the same time before sunrise. They take long flights in search of food and like to go away shortly after feeding, for which reason they may be said to change every twenty-four hours, at least during the warm weather, only very few (about 1 per cent.) being consequently found infected in the height of summer. As the weather becomes colder they remain longer and a large proportion (about 8 per cent.) are found infected. The infected insects are apt to be conveyed passively over long distances and so spread infection to fresh localities hitherto exempt. *Anopheles* are found in some places where no malaria exists as, *e. g.*,

along the Lake of Como. Their larvæ live freely in salt water, and seaside places, though usually exempt, are not invariably so. Professor Grassi, in conclusion, confirms the observations of Christophers and Stephens on the occasional presence in the salivary glands of the *culex* of bodies which resemble, but which he does not believe to be, sporozoites. He calls them pseudo-sporozoites.

A PAPER on the metric system read by Mr. Rufus C. Williams, president of the New England Association of Chemistry Teachers, has been published in a pamphlet by the Decimal Association of London. It gives a very clear account of the advantages of the metric system. Mr. Williams reports that under the Government the system is used in the following cases:

1. In the Department of the Coast and Geodetic Survey, the meter was adopted as the standard in the beginning and has been so used ever since.

2. In the Agricultural Department, in all scientific work in chemistry, etc.; and in the Natural History work metric measurements are exclusively used.

3. The Post Office Department uses it for foreign mails to metric countries, but not for domestic. Postal cards are of metric dimensions, and certain coins have been made to metric weights and measures.

4. In the Department of Surgeon-General of the Army and also that of the Navy, all contracts for medical supplies embody the metric system, and all containers—boxes and bottles—are of metric dimensions.

5. Regulations for U. S. Marine Hospital Service, 1897, made its use compulsory.

6. In Cuba and Porto Rico the Government uses the system exclusively in all official and domestic work. These countries adopted it years ago.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. ANDREW CARNEGIE proposes to erect and furnish buildings for a polytechnic school in Pittsburg, giving it an endowment fund of $1,000,000. The city of Pittsburg is to furnish the site.

THE amendment to the constitution of the State of California, permitting Leland Stanford Jr. University to receive bequests from those not citizens of the State, and permitting the legislature to exempt part of the property of the University from taxation, was adopted at the recent election.

WE recorded last week the partial destruction by fire of the N. Y. State Veterinary College of Cornell University. It appears that the damage to the building, which is estimated at $30,000, is covered by insurance. The departments of histology and bacteriology, however, lost equipments valued at $25,000 and collections that can scarcely be replaced. The loss of Professor Gage's collections, made in the course of twenty years, is especially serious. It is thought possible that the fire originated in the lamps of incubators in the department of bacteriology which were kept burning all night.

PROFESSOR GEORGE J. BRUSH, of Yale University, has given $1,000 to a special fund for the Sheffield Scientific School. The general funds of the school have been increased by a gift of $2,500 from an anonymous donor. The university has also received the following gifts and bequests: $5,000 from Mrs. Isaac H. Bradley, the income of which is to be devoted to a course of lectures on some subject connected with journalism, literature or public affairs; $700 by the will of the late James Campbell, of the medical faculty, to maintain the senior prize, provided for by him since 1888 and known as the Campbell gold medal; $1,000 from Mrs. H. F. English for the Alice Kimball English prize fund in the Art School and $1,000 from ex-President Dwight for the general funds of the Art School.

JAMES MILLIKEN, the Decatur (Ill.) banker and philanthropist, has added $400,000 to his gift to the proposed industrial school to be established in Decatur. He had previously given $316,000. Citizens gave $100,000, and the Cumberland Presbyterian churches of Illinois, Indiana and Iowa will give $100,000.

A COMPOUND engine to be placed in the boiler house erected by President Morton in connection with the Carnegie Laboratory of Engineering has been presented to the Stevens Institute of Technology by the Stevens family at Hoboken.

DR. A. KOSSEL, professor of physiology at the University at Marburg, has been called to Heidelberg.